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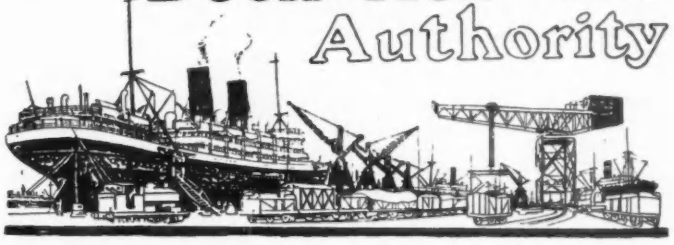

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Editorial Comments

The Port of Long Beach.

Long Beach, a city of Los Angeles county, California, U.S.A., is situated on San Pedro Bay, twenty miles south of Los Angeles. It's perfect climate and excellent holiday facilities have made it one of the most popular holiday resorts of the State. A wide beach over seven miles long, sloping gradually to the sea, is considered the best on the coast for all the year round bathing, and in front of the city, lies Catalina Island which protects it from cold winds and violent storms. The district is important as a manufacturing area, with a number of steel works, a Ford assembling plant, and extensive canneries. An idea of the exceedingly rapid growth of the city can be appreciated when it is realised that as recently as 1890, Long Beach was merely a fishing village, and in 1900 the population was little over 2,000. By 1920, the number had increased to more than 50,000 and this number has again more than trebled during the past few years.

The Port is equipped with up-to-date quays and warehouses and has a fine harbour with a depth of 40-ft. of water and 17 square miles of anchorage. It is connected by the Cerritos Channel with Los Angeles Harbour which lies immediately to the west. In fact, these two harbours form one great commercial gateway, in the development of which, the Federal Government and the two municipalities of Long Beach and Los Angeles are co-operating.

An article describing the Port of Los Angeles appeared in the August 1940 issue of this Journal, and we now have pleasure in printing in this issue a full description of the Port of Long Beach. From this it will be seen that the Port and Municipality of Long Beach is fortunate in having oil fields within the city and it's environs, so that receipts from oil royalties have paid for all the cost of Port works.

Of the improvements to the Port already completed, mention should be made first of the magnificent transit sheds of steel and reinforced concrete, erected at Pier A in the Outer Harbour, of a type now adopted as standard. The outstanding feature of these sheds is the clear unobstructed floor area of from 120 to 200 feet wide by 1,000 to 1,152 feet long, with a clear headway of 32-ft. There are other advantages in the layout of the sheds, such as extra wide quays to enable modern stevedoring equipment to operate freely and large paved open storage areas. Attention is directed also to the facilities provided for loading bulk exported cargoes of many diverse kinds by means of one adaptable conveyor system.

The use of "Monotube" steel piling for fire resisting construction will be new to many of our readers and we hope to be able to provide, at a later date, some details of this system.

Also of considerable interest is the installation of Radar as a navigational aid, involving a procedure which appears to be similar to that employed at Douglas, Isle of Man, an account of which appeared in the April 1948 issue of this Journal.

The Future of the Canals.

In our correspondence columns is published a letter commenting upon the article by Mr. Ives on the Inland Waterways of the United Kingdom, which appeared in the May issue of this Journal. Our Correspondent who for various reasons wishes to remain anonymous, raises a number of points which undoubtedly require ventilation, and we reproduce his letter in the hope that it will stimulate replies to the various questions, and initiate an informative exchange of views and knowledge, the dissemination of which cannot be anything but helpful to all concerned.

Our own comment upon the matter is that it is perhaps a little too early yet to expect from the Docks and Inland Waterways Executive a solution of many of the problems resulting in some instances from years of neglect, or the emergence of a long term policy of modernisation of every aspect of the Canal industry. No doubt in the transitional period of only twelve months, the Executive has been mainly concerned with the resolution of problems requiring immediate attention.

As far as the contents of the letter is concerned, we agree that publicity is of the greatest importance as a factor for securing adequate traffic on the canals and we hope to see, in due course, an intensive publicity campaign coupled with a revision of rates. We also hope that by the time the desired increase in traffic has been secured, the arrears of dredging and maintenance of the canals, locks, plant and handling equipment will have been so far completed as to enable the Executive to deal with the added business with the efficiency, celerity and cheapness which alone will secure for the waterways their ultimate prosperity and rightful place in the transport system.

"Windlass" is especially concerned with the necessity for improving the conditions of canal boatmen and the education of their children. These questions we agree should receive immediate attention if the drift away from the canals is to be arrested and new employees of the right type attracted to the industry.

We have to concur unfortunately with much of what "Windlass" infers as to the lack of co-operation between various public authorities, Government departments and other semi-public organisations. In the case however of the two power stations mentioned we are not in possession of all the circumstances, but in any event, the siting and coaling arrangements would be primarily the concern of the British Electricity Authority and not that of the Docks and Inland Waterways Executive. The water abstracted for cooling purposes is of course returned to the canal, which is therefore only affected in so far as the purity and temperature of the returned water is concerned.

With regard to long term plans for modernising the British canals, there is no doubt that although Inland Water Transport is of less importance in the United Kingdom than upon the Con-

Editorial Comments—continued

tinents of Europe or America, it can form a valuable integral part of the country's transport system and the Docks and Inland Waterways Executive have an unprecedented opportunity for securing this admirable result.

The problem of widths of the existing canals and locks is one which may need some careful consideration in order that the limitations of those of narrow gauge may not be a too serious handicap to their holding the important place they deserve in the canal system, linking together as they do the four operating groups or Divisions.

The National Dock Labour Board.

Elsewhere in this issue are printed the salient points of interest in the First Annual Report of the National Dock Labour Board to the National Joint Council for the Transport Industry. The report is accompanied by Appendices which give complete information as to the composition of the labour force, its disposition, groups, daily earnings and finance, etc. all of which are of interest, but too lengthy for reproduction.

There is no doubt that the Board has had, in its first six months, a task of considerable magnitude in transferring and co-ordinating into the new Scheme, the work of the old National Dock Labour Corporation and the Schemes previously administered by the Ministry of Transport. This task appears to have been carried through most creditably.

For the period dealt with by the Report, it appears that the Board has been content, where matters of policy affecting labour and finance are concerned, to deal merely with those requiring a quick solution, and have avoided establishing precedents which would be contrary to the dictates of a long term policy. It may be for this reason that we find the question of the recruitment of the Labour Force is only briefly referred to. In this connection, there have been suggestions that the Industry is over-manned by reason of the redundancy of men in many labour gangs.

Mechanisation of cargo handling is but vaguely mentioned in the Report and the prevailing labour unrest and constant unofficial strikes are not mentioned at all, so there is no record of the time lost through these disturbances.

It would appear that the majority of the strikes of the past twelve months in this country—all of them unofficial—have commenced with refusals to work mechanised cargo handling gear, unless some quite inordinate demands in respect to rates of pay or numbers of men to be employed in the gangs are first met. This attitude of the workers needs to be radically changed before much improvement in speed of cargo handling can be effected.

The disturbing feature is that decasualisation of labour, together with the reforms brought about by the Dock workers (Regulation of Employment) Act of 1946, which include such advantages as regular employment, guaranteed payments, attendance money, improved wages, holidays with pay, port medical and welfare services and so on, have not resulted in a more contented labour force. On the contrary, many sections of it seem to be even more irresponsible, and apt to use every opportunity to secure an immediate advantage to themselves without regard to their obligations to the community.

In this respect it is obvious that the relations between the Unions and their members are not all they should be, as evidenced by the indiscipline which is apparent. It may be that, because certain Union officials are part of the N.D.L.B. machinery, the men tend to identify their officials with the "boss." In any case the reasons for the men's lack of co-operation with the Union leaders should be closely enquired into, and whatever is found to be wrong, should be remedied without delay.

The Economics of Timber Substitution.

The necessity for restricting imports of timber during the post-war years has continued for several reasons, the principle one being the present fiscal and financial position of Great Britain, that is to say, the economic aspects of the situation still continue to be more important than technical considerations.

It is natural therefore, "necessity being the mother of invention," that substitute materials have been found for a large number of purposes for which it had been customary to use timber. As a result, timber importers and the timber industry generally in this country, are now being subjected to considerable competition, and the Timber Development Association a non-trading organisation formed for the purpose of making better known the advantages of wood to present and potential users—has recently published a booklet entitled "The Economics of Timber Substitution" which contains information of interest to all who use timber in quantity.

The booklet is reviewed elsewhere in this issue, and the arguments put forward by the Association for conserving our home produced steel and for exporting it in manufactured form in return for supplies of timber, appear to be well founded. There is also much to be said in support of the reasons given for now discontinuing the use of aluminium as one of the major substitutes in house building.

We are of the opinion however, that among the list of instances quoted by the Association, in which the use of timber has been superseded by a substitute, the latter, in a large number of cases, has proved itself more suitable on both economic and technical grounds. As an example take the use of reinforced concrete in place of timber for piled jetties and other marine structures, the initial cost may be greater, but in respect to durability and reduced cost of maintenance, the substitute can more than hold its own. The same argument applies in the case of steel windows, which are specially mentioned by the Association, and many other examples could also be quoted.

The use of pre-stressed concrete for beams and joists is a technique the adaptations of which are not yet fully explored, but which however, is growing in popularity not only in this country, but also abroad. Here again, the use of concrete is not wholly dictated by shortage of timber.

In years to come, progressive improvements are to be expected in all classes of manufactured articles, and timber is merely a medium of production just as are steel, aluminium, concrete, bricks and so on. It has certain applications in which it has no equal and is in no danger of being ultimately superseded, but whatever efforts are made to increase its use in other directions, its suitability and the economics of supply and demand, apart from the present unusual circumstances, will finally decide the matter. Nor must it be forgotten that however much growing timber there may still be standing for the use of the present and following generations, at the same time the supply of timber in the world is by no means inexhaustible.

We notice that the Timber Development Association frequently refer to the saw mills as "the producers." They are of course merely producers in the sense that they are tree fellers and sawyers, and as a general rule they have nothing to do with afforestation.

It is uneconomic to ruthlessly fell timber without at least keeping pace with consumption by adequate re-afforestation. Moreover it is now generally realised that a vast amount of soil erosion and even considerable alterations in climatic conditions and rainfall have been and are being caused in many countries through the unrestricted exploitation of forest land. As a consequence, the control of timber cutting and re-afforestation, is now a matter of world importance, and is receiving the attention it deserves from the Food and Agriculture Organisation of the United Nations and of the many Governments concerned.

Off-Shore Boring for Oil.

In the April issue we printed a short article upon the adaptation of radio to the surveys and position fixing necessary for the purpose of under sea oil exploration and recovery.

We are fortunate in now being able to follow this with a description of an oil-drilling platform constructed in fifty feet of water in the Gulf of Mexico—an area notorious for hurricanes—and upon ground anything but good.

An essential feature of the structure, which merits careful attention is the use of prefabricated steel tube frames or "Templets," which enabled the pile driving and construction at site to proceed with great rapidity and provided quite simple cross bracing at the sea-bed level, i.e., where most required for lateral strength.

The steel joist piles of great length driven within the tubes derive their sustaining power by means of skin friction alone and have the unusual penetration of from 147-197 feet.

It seems that the "Templet" technique, if more widely known in this country, might be adopted and used with great advantage in similar deep water situations around our coasts.

Aerial view of the Port of Long Beach with the City in the background.

The Port of Long Beach, California

A Modern and Progressive American Port

(Specially Contributed)

Early History

THE history of the Port of Long Beach dates back to 1542 when Juan Rodriguez Cabrillo, a Portuguese sailing under the Spanish flag, sailed up the West Coast of Mexico, discovered the Catalina Islands and sailed into what is now known as San Pedro Bay, but which he named "Bahia de Los Fumos," because of the numerous smokes which he saw surrounding the bay. The smokes, it is now known, were caused by the Indians burning off the grass of the plains during one of their rabbit drives.

The next known ship to enter the bay was in 1602, just 60 years later, when Sebastian Viscaino, a Spaniard sailing under the Spanish flag, entered the bay and, not knowing that it had previously been named by Cabrillo, called it San Pedro Bay, after the saint whose day it happened to be. This was four years before the colony of Jamestown was founded in Virginia. It was Viscaino who gave many of the bays and promontories of the Coast of California their present day names.

It was not until 1805 that the first cargo ship, the "Leila Byrd," entered San Pedro Bay, bringing in spices and merchandise from Boston and taking out a cargo of hides and minerals from the desert mines of California and its neighbouring states. At that time it was necessary to anchor the "Leila Byrd" off-shore and bring the cargo in small boats to what is now known as Point Fermin, where they were carried through the surf and hoisted over the bluff. The land area now comprising the Port of Long Beach was at that time a dismal swampland and could not be used for handling cargoes. Later on, merchandise was lightered through a winding channel around Deadman's Island, several miles inland to a landing at Wilmington, which was located near the point where the Catalina Terminal now stands. In those days wagon trains hauled the cargoes from what is now the port across the Colorado desert to the mines of Arizona and returned with the minerals which were to be exported.

Early Harbour Works

There was very little development of the Port of Long Beach itself until 1906, when the Los Angeles Dock and Terminal Company, a private corporation which had acquired title to 800 acres of lagoons, tidal sloughs and salt marshes in the lowlands at the westerly portion of Long Beach for a reputed price of $500,000, commenced the development of a private harbour. This locality is now known as the Inner Harbour of the port. The Los Angeles Dock and Terminal Company had obtained permission from the War Department to dredge certain navigable channels and were successful in compelling the San Pedro, Los Angeles and Salt Lake Railroad Company to remove a trestle and dam which the railway company had placed across the old San Gabriel River at its outlet into the Pacific Ocean. This outlet was to become the entrance channel to the Inner Harbour.

A 180-foot bascule bridge, which provided the port with its first railroad service, was then erected by the railway company in approximately the same location. However, the bridge was subsequently removed in 1935 to permit unimpeded use of the entrance channel.

The operations of the Los Angeles Dock and Terminal Company called for the dredging of three channels, designated as Channels

Port of Long Beach, California—continued

1, 2 and 3, spreading northerly and easterly from a turning basin which was connected with the Pacific Ocean by the 300-foot entrance channel. This entrance channel, located at approximately the outlet of the old San Gabriel River, was protected by rock jetties projecting into the ocean on either side of the channel.

In 1907 construction was started on the Craig Shipyard, which was the first major industry to be built in Long Beach Harbour. In 1908 an application was filed with the War Department for a permit to dredge a channel to connect the proposed Long Beach

View of a portion of Pier A in the Outer Harbour. The farthest shed is the oldest transit shed in the area, having been completed in 1940. The two sheds in the foreground are steel and concrete, clear span sheds, the type that is now being constructed throughout the harbour.

Inner Harbour with the Los Angeles Inner Harbour, the channel to follow approximately the course of the winding narrow natural channel which was known as Cerritos Slough. This permit was subsequently granted by the War Department and the channel is now known as Cerritos Channel.

In 1909, the first bond issue to cover the purchase of property and the development of the port was approved by the voters of Long Beach. This bond issue was in the amount of $245,000 and provided for the purchase of certain water-frontage in the Inner Harbour and the construction of a pier, wharf and shed, which was completed by September of 1910.

The first cargo was unloaded at a municipal dock on June 24, 1911, when the S.S. "Iaqua" unloaded 280,000 feet of hardwood from "Eureka" at the newly completed municipal dock in the Inner Harbour, now known as Pier 1. The first regular steamship service was inaugurated by the "Santa Clara" of the old North Pacific Steamship Company in 1912, carrying passengers and freight coastwise.

Flood Control Difficulties

For some time the Los Angeles Dock and Terminal Company attempted to continue its development programme, but experienced great difficulties by reason of floods and the fact that the river which flowed through the harbour became a raging torrent during the winter season and would fill in the dredged areas with huge quantities of sand and silt. These floods were so severe in 1913-14 that many predicted that there would never be a port in Long Beach. Because of these difficulties, the dredging project was turned over to the City of Long Beach in 1916 and the City received a deed to the channels and to a 4.7 acre parcel of land lying near Slip 5. The citizens then voted a second bond issue of $300,000 to complete the dredging of the channels in the Inner Harbour and the Turning Basin.

To curb such destruction and silting which was caused periodically by the river, a Los Angeles County Flood Control District was formed and this district issued $4,450,000 in bonds, to which an additional $1,080,000 was contributed by the state and federal governments, to construct a silt diversion channel. The federal government began construction on this channel, which is now known as the Los Angeles County Flood Control Channel, in 1919 and completed the work in 1923. By means of this project, the waters of the Los Angeles River now empty into the Pacific Ocean easterly of the harbour, thereby making permanent port development possible in the Port of Long Beach without the danger of floods and silting.

In 1924, the voters of Long Beach approved a $5,000,000 bond issue which was used principally in constructing a 7,284 foot breakwater along the southerly prolongation of the westerly bank of the Los Angeles Flood Control Channel, and in the construction of the east and west moles and bulkheads for the protection of the entrance channel. All of these projects were completed by 1928, and in the same year the voters approved a bond issue in the amount of $2,700,000 for the construction of additional piers, wharves and similar facilities. The reconstruction of the present Pier 1 and the construction thereon of a transit shed with an area of 40,000 square feet were also commenced. A municipally-owned rail line to serve the harbour district was also constructed at this time.

The 1928 bond issue in the amount of $2,700,000 proved to be the last bond issue necessary, as oil was discovered just west of the City limits and north of Cerritos Channel in 1936, and proceeds from oil development since that time have provided for the retirement of all outstanding bonds and the interest thereon and are providing for the development of the port.

The Present Port

To-day, the Port of Long Beach is a man-made harbour, designed to meet the needs of present-day shipping and commerce. It enjoys close proximity to the business, hotel and recreational activities of the city of Long Beach, provides easy access to the open sea without long and difficult passages through harbour channels and is adjacent to a market of almost 4,000,000 people within an area of less than 100 miles. It is served by three trans-continental rail lines, 1,100 miles of inter-urban electric railways, a harbour belt line, and a vast network of highways radiating to all parts of the nation.

The harbour district of the port comprises the entire section of the City of Long Beach lying west of the east line of the Los Angeles River Flood Control Channel and the south-easterly prolongation thereof, and south of the north line of Anaheim Street. Geographically, the port area is divided into two sections, the Inner Harbour and the Outer Harbour.

The Inner Harbour

With the exception of two large municipally owned piers, most of the Inner Harbour frontage is privately owned by various companies or individuals. The Inner Harbour has quick access to the sea through a fairway leading from the publicly-owned channels and turning basin through the Outer Harbour.

Piers 1 and 2 are the only municipally owned areas in the Inner Harbour, with the exception of two or three small parcels of land which are not waterfront property. Piers 1 and 2 have eight municipal berths, two transit sheds which are 82-ft. by 450-ft. and 82-ft. by 510-ft., and two smaller sheds with an area of approximately 12,000 square feet. The reconstruction of Pier 2 is just being completed following the disastrous fire of December 5, 1945, and plans are under way for a transit shed to be built

LEGEND

1. Long Beach Salt Works
2. L. B. Municipal Gas Plant
3. United Concrete Pipe Corp.
4. J. H. Baxter & Co.
5. J. D. & A. B. Spreckels Co.
6. Richfield Oil Co.
7. Procter & Gamble
8. L. B. Marine Repair Co.
9. Golden State Sea Food Co.
10. California Sea Food Co.
11. P.E. - S.P. Freight Station
12. A.T. & S.F. Freight Station
13. Southern Pacific Railroad
14. F. P. Newport Co.
15. Title Insurance Trust Co.
16. F. P. Newport Co.
17. Graham Bros., Inc.
18. Sully Miller Contracting Co.
19. Richfield Oil Co.
20. Harbor Dept. Supply Yard
21. Southern Pacific Canning Co.
22. Standard Gypsum Co.
23. Craig Shipbuilding Co.
24. West Coast Packing Co.
25. Ford Motor Co.
26. Fellows & Stewart
27. Spencer Kellogg & Sons
28. So. Calif. Edison Co.
29. Harbor Dept. Supply Yard
30. Union Pacific Freight Depot
31. Long Beach Harbor Dept.
32. Long Beach Oil Development
33. Richfield Oil Co.
34. Army & Navy YMCA
35. Navy Landing
36. Hughes Aircraft Co
37. Guy F. Atkinson

PORT OF LONG BEACH
CALIFORNIA

Port of Long Beach, California—continued

thereon of approximately 140,000 square feet. In addition, there are eleven private berths in the Inner Harbour developed for large craft as well as many berths used for small craft.

The Outer Harbour

The Outer Harbour, with the exception of the Navy Base, which is in the West Basin area, is municipally owned in its entirety and its development is being rapidly carried forward by the Board of Harbour Commissioners. There are now available twenty deep water municipal berths in the East Basin portion of the harbour and an additional ten berths will be added to this figure when Piers B and C are completed. Three transit sheds have been completed, the tranist shed at Berths 1 and 2 measuring 120-ft. by 1,000-ft., the transit shed at Berths 3 and 4 measuring 120-ft. by 832-ft., and the transit shed at Berth 5 measuring 120-ft. by 608-ft. The world's largest clear span transit shed, 200-ft. by 1,152-ft. in size, is under construction at Berths 6 and 7.

The entire Outer Harbour area is enclosed by solid fill mole construction, which has eliminated all rough water and resulting surge. In addition to the Pier A breakwater and the navy mole whtich enclose the Outer Harbour, the federal breakwater which lies approximately 3 miles off-shore, also furnishes added protection to the port and extensive safe anchorage areas.

While total municipal investment in the harbour to date exceeds $25,000,000, the port's assets, exclusive of its oil holdings, are valued greatly in excess of this amount.

Value of the Port to the Community

It would be very difficult to enumerate all the benefits accruing to the nation from the operation of its ports. In time of war, the ports are extremely essential to the nation's security and without these ports the nation's overseas forces could not have been supplied. The communities in which the ports are located benefit even more directly, as history has shown that, in time of peace, the most properous communities and the most prosperous nations are those which engage in world trade. A comparison of the population, industrial development and standards of living in the areas immediately adjacent to port communities will show that they, as a rule, are far advanced over other areas.

The value of a port is reflected indirectly in lower costs of practically every commodity that can be handled by water transportation. Such lower costs result from lower water freight rates and also from rail rates which are low enough to meet water competition.

More usual commodities entering the Port of Long Beach are Philippine hemp; copra and vegetable oils from the South Seas; crude rubber from the East Indies and Malaya; coffee from Brazil, Columbia and Central America; tea from Japan, China and India; raw silk from Japan and China; newsprint from the Pacific Northwest and Scandinavian countries; cotton, lumber, steel and manufactured products of all kinds. Exports clearing are oil and other petroleum products, citrus fruits, coal, gypsum, potash, borax, rock salt, and an ever-increasing amount of manufactured goods from Southern California.

Commerce Handled Through the Port

The following table shows the annual Harbour Department tonnage during the ten-year period of 1938-47, inclusive, over both private and muncipal terminals:

Year.	Tons.	Value ($)	Year.	Tons.	Value ($)
1938	2,324,817	43,746,739	1943	3,688,800*	128,320,000
1939	3,070,016	86,016,245	1944	4,262,933*	123,151,722
1940	2,969,712	71,478,129	1945	5,928,777*	115,903,798
1941	3,385,000	103,049,337	1946	3,519,027	147,384,432
1942	2,550,000*	123,573,899	1947	3,997,481	312,976,234

*Largely Military Shipments.

Petroleum Activities of the Port

The story of petroleum activities in the harbour district begins in 1936 when the General Petroleum Corporation, having completed a seismograph survey with favourable indications and having obtained leases in the area, completed their "Terminal" No. 1 well, from which the Terminal Zone was named, just west of the Long Beach City limits and north of Cerritos Channel. A production of 1,400 barrels per day was obtained from this well at a depth of 3,625-ft.

Following the completion of this discovery well, drilling activity increased rapidly both in the town lot area of Wilmington and on the large Union Pacific and Ford leaseholds just west of the Long Beach City boundary. However, due to restrictive ordinances in effect, it was not until November, 1937, that areas within the Long Beach City limits were opened up for drilling, and these areas were limited to that portion of the city lying to the west of the Los Angeles River Flood Control Channel. On March 15, 1939, the City of Long Beach, acting through its Board of Harbour Commissioners, entered into four drilling and operating contracts with the Long Beach Oil Development Company and later additional contracts were entered into. The lands covered by these agreements were all tideland properties and under the terms of the contracts the city receives a minimum royalty of 30% from the production of the wells until the costs per parcel of drilling the wells have been reimbursed, after which the city receives 85.55% less the actual cost of production of the wells.

In March, 1947, a joint contract was entered into by the City of Long Beach and the Board of Harbour Commissioners with the Richfield Oil Corporation. This provides for the development of 245 acres of tidelands lying just east of the harbour district and south of Seaside Boulevard from drill sites located in the harbour district on Pier A East. This contract is even more advantageous to the city inasmuch as it provides that the city will receive a minimum royalty of 60.1% from production until Richfield Oil Corporation is reimbursed for the actual cost of the wells, after which the city will receive 94.1% royalty less the actual cost of production. The actual cost of drilling and producing the wells is limited as in the case of the Long Beach Oil Development Company contracts.

At July 1, 1948, the Harbour Department, acting for and on behalf of the City of Long Beach, owned and operated 387 oil wells which had been drilled by the Long Beach Oil Development Company and 41 oil wells which had been drilled by the Richfield Oil Corporation, all of those wells being tideland wells. The total rate of oil production at that date from both companies amounted to 48,000 barrels per day.

In addition to the tideland wells, the city owns or has an interest in 66 upland oil wells with a daily production (July, 1948) of 9,000 barrels. These wells have been drilled by various operators, and the royalties accruing to the city from them, depending upon the city's leasehold interest in each well, range from 9.1% to 62.5%. The revenues from them accrue to the General Bond Interest and Redemption Fund of the city and average approximately $203,000 per month plus an additional $20,372 per month from oil well permits, etc., making a total of $223,372 per month, which have provided sufficient money to meet all general bond and interest requirements of the city to final maturity by April 1, 1949. After that date, if no new bonds are issued, the City of Long Beach will be free of bonded indebtedness and all upland oil revenues will accrue to the General Purpose Fund of the city.

By virtue of the combined production of oil from the tideland and upland oil wells, in excess of 57,000 barrels per day, the Harbour Department is the fourth largest producer of oil in the State of California. In addition, after the natural gasoline is extracted, the Harbour Department furnishes the resulting dry gas to the City Gas Department free of charge.

Facilities of the Port

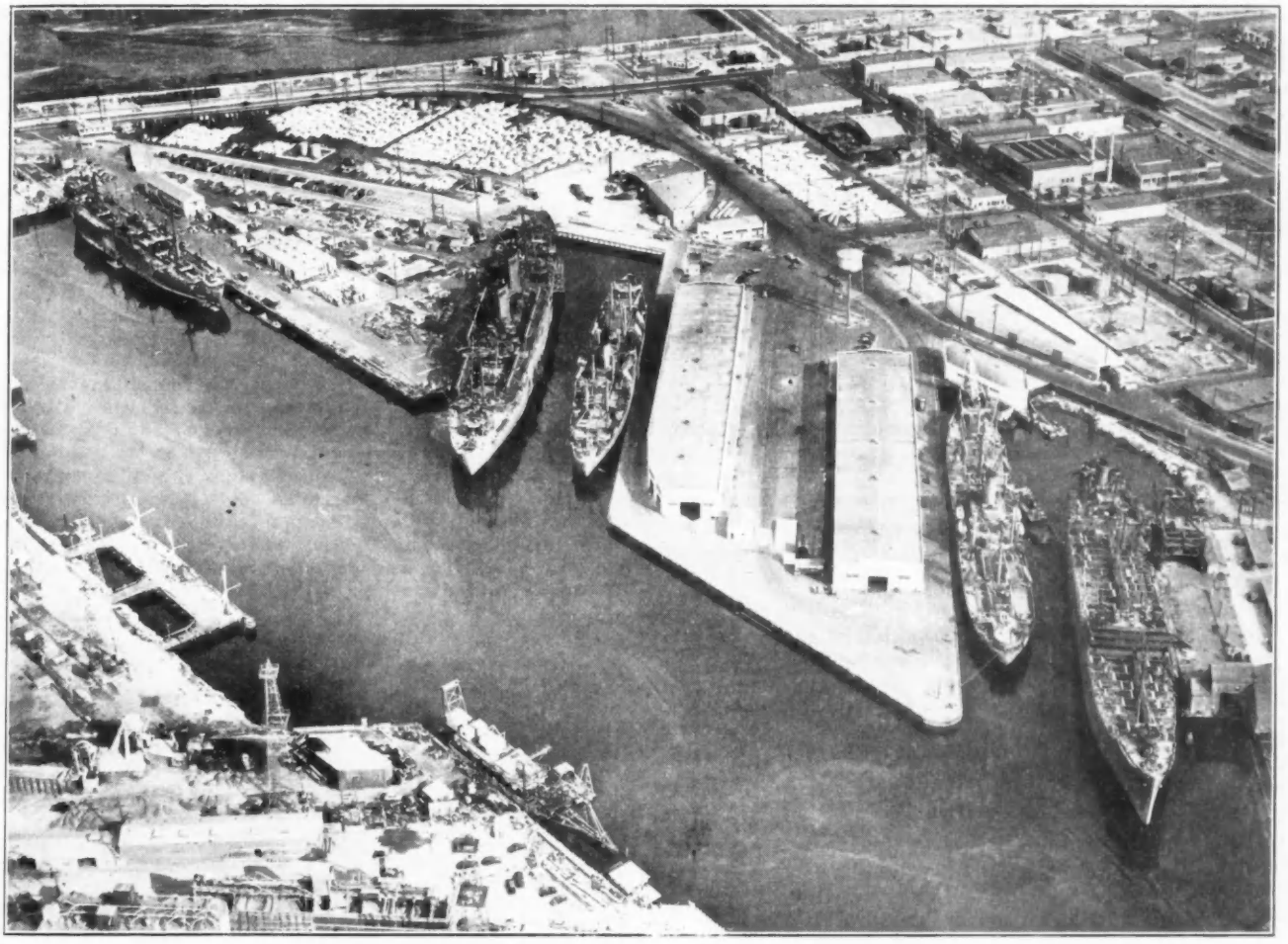
The present major physical features of the port are as follows:

(1) 85,280 linear feet of existing deep water frontage, including municipal, federal and private.
(2) 15,200 linear feet of improved private frontage.
(3) 12,000 linear feet of improved municipal frontage.
(4) 25 muncipally owned deep water berths; 11 privately owned deep water berths; and 20 federally owned deep water berths (Navy base).

Port of Long Beach, California – *continued*

(5) 6 modern muncipal transit sheds.
(6) Foundations in place for 3 additional transit sheds serving 6 berths.
(7) 40-feet minimum depth of water at low tide.
(8) Unusually large paved open storage areas.
(9) Ample automobile parking space.
(10) All permanent utilities systems underground in the Outer Harbour area, eliminating danger to high cargo handling equipment.

Clearance for standing trucks.
Increased door height, maximum door width.
Increased natural light.
Improved artificial lighting and automatic sprinkler system.
Canopies over rear loading platforms for shelter of cargo during loading or unloading.
Smooth, well-drained floors with proper drainage at each door.



Aerial view of the Port of Long Beach showing Pier No. 1 (right centre) and Pier No. 2 (upper left of centre). These piers are located in the Inner Harbour.

An outstanding feature of all developments already installed and those planned for the future is the concrete and steel fire-resisting construction. For instance, in the construction of the piers, "Monotube" steel piling, a hollow, fluted steel piling, is driven into the ground, filled with steel-reinforced concrete and capped with concrete. Corrosion is counteracted by cathodic protection. Interlocking steel sheet pile bulkheading supports the earth fills and concrete wharf decks are standard throughout for new work. It is interesting to note that for its port development alone, Long Beach purchased 37,000 tons of steel worth $3,146,000, the largest steel order on record by any single municipality. The new steel and concrete transit sheds offer the following advantages:

32-ft. clear height.
120-ft. to 200-ft. wide, unobstructed floor space.
From 33-ft. to 51-ft. extra wide apron wharves, room for modern stevedoring equipment to operate, fire-resisting construction.
20-ft. extra wide loading platform for manœuvreability of equipment.
Outlet plugs for 110-220-440 volt power and light, both single and three-phase.
Water outlets equipped with backflow protection devices to prevent pollution of water supply.

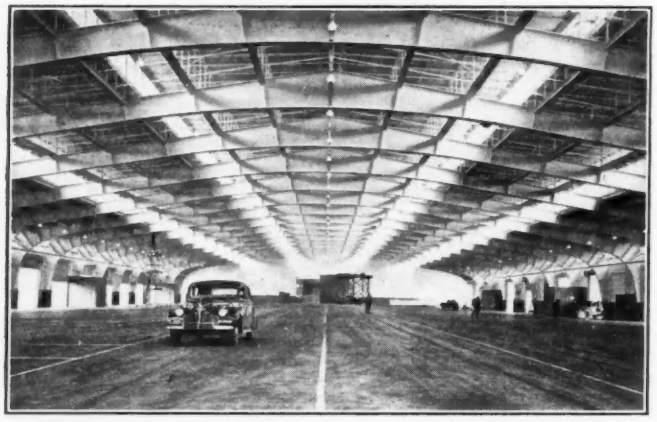
Bulk Loading Conveyor

Of particular interest to shippers of bulk cargoes such as coal, petroleum coke, potash, sulphur, salt cake, cement, gravel, sand, etc., total weight of which does not exceed 150-lbs. per cubic foot and the total size of which does not exceed approximately 14-in., is the bulk commodity terminal which is located at Berths 33-34 in the Outer Harbour. This facility can load bulk products aboard ship at the rate of 250 tons or better per hour. By this method a ship can be fully loaded in 55 to 60 hours, whereas older methods would require from one to two weeks.

In operating the conveyor, bottom-dump hopper cars are spotted on the wharf tracks directly over a series of steel-lined hoppers, which are housed in a reinforced concrete housing below the deck level. Fed through gratings and on to shakers, the

Port of Long Beach, California—continued

cargo is then dropped mechanically to the endless belt conveyor which elevates it to such height in the conveyor tower as will permit it to be dropped upon a secondary belt conveyor and transferred horizontally to a point over the ship's hatch, from which



Interior photograph of clear span transit shed at Berth 5, the transit shed which is shown in the immediate foreground in the illustration on Page 36.

it is dropped into the hold and trimmed by trimmer devices adaptable to whatever commodity is being handled. Operation is powered entirely by electricity.

Railroad yard capacity for some 150 cars of bulk cargo exists on the approaches to this pier, and tail track capacity on the pier itself beyond the hoppers into which the cargo is dumped will accommodate an additional 50 cars, which can be dropped back one by one, either manually or mechanically, as they are emptied and made ready for switching operations.

Comparatively little effort is required to change from one type of cargo to another. A small amount of cleaning of the conveyor belts and those parts of moving and stationary equipment with which the cargo comes in direct contact would be necessary for certain commodities. For example, after handling coal it would be necessary to do a small amount of washing and clean-up work before potash or other white products could be handled. The time and cost of such clean-up is very small.

Radar Installation

Marking an important advance in navigational aids, the Port Authorities have installed what is claimed to be the first port radar control system in the western hemisphere. The principal object in establishing such a radar control station is to provide a safe medium for the movement of shipping in and out of the port during periods of low or even zero visibility, and to serve as an aid to the pilotage of ships in and about the harbour. It is believed that this installation will entirely eliminate the necessity of ships lying offshore while awaiting the lifting of heavy fog banks which occasionaly roll in from sea.

The radar scanner and certain other equipment is mounted on a 122-foot steel derrick located alongside the Port Pilot Station at the southernmost tip of Pier A in the Outer Harbour, with the viewing scope and radio equipment located in the pilot station proper. The radar equipment was furnished by Sperry Gyroscope Company and was installed by the Kuster Wetzel Company of Long Beach.

By means of the new radar control, it will be possible to (a) observe and locate all ships in the harbour area within a distance of 30 miles; (b) direct the pilot boat accurately to any ship within a radius of 5 to 10 miles; (c) guide the pilot by the master radio control station located in the pilot house, through walkie-talkie radio communication, and thus enable him to bring the vessel through the entrance opening in the breakwater system to any desired berth in the harbour; and (d) in the case of a vessel leaving the harbour, direct the pilot boat back to the pilot station.

The radar sysem, in general, consists of the following equipment:—

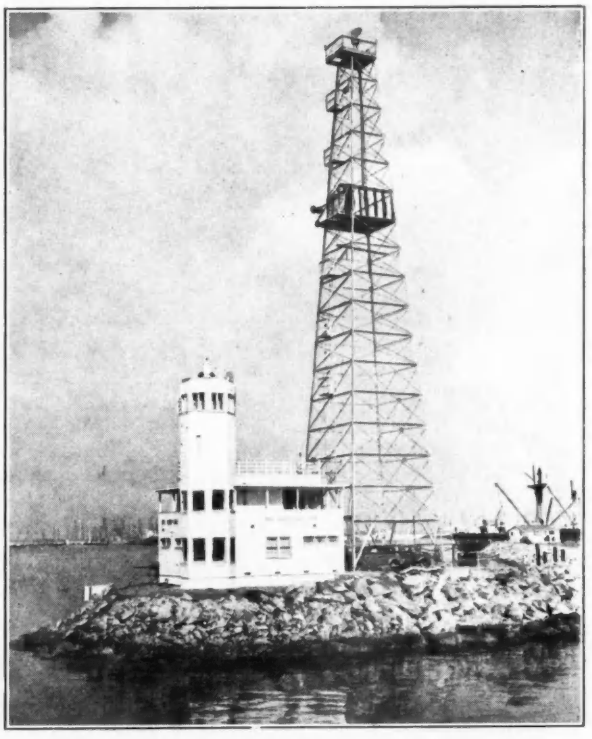
(a) Scanner-antenna mounted on top of the 122-foot steel tower.
(b) Transmitter receiver, mounted in the tower.
(c) Indicator console (scope), mounted in the pilot house. This scope will give the operator a picture of all ships, breakwaters and all other obstacles in our harbour area.
(d) Miscellaneous equipment such as radar reflectors, viewing scope hood, spares, installation drawings, and instructions for maintenance and operation.

The communication equipment will provide two-way voice communication between the pilot station and pilot boat and similar communication between the pilot station and the pilot aboard the incoming or outgoing vessel, by use of the following equipment:—

(a) Fixed radio transmitter-receiver in the pilot station.
(b) Mobile radio transmitter-receiver in the pilot boat.
(c) Portable transmitter-receiver radios (walkie-talkies).

The procedure for a ship approaching the port during a period of heavy fog and resultant low visibility is similar to that employed by airports, and the radar system used corresponds to the ground control approach system for aircraft. In reality, the G.C.A. is a mobile radar station and even in thick fog the pilot of the approaching plane is "talked down" the glide path to within 50-feet of the centre of the runway. Likewise, the Port of Long Beach radar control station operator will contact the incoming ship after the pilot has boarded the vessel, and will then manœuvre her into position for an approach down the entrance fairway, track it in range and bearing, and "talk the ship" into the harbour and to the proper berth. The radar control will be accurate to within a margin of 50-feet, which is the same tolerance allowed in the radar approach system for aircraft.

This radar installation is being made by the Port Authority as a service to shipping and there will be no additional charge for its use. Surveys have been made of the various shipping firms



View of Radar Tower, 122-ft. high adjacent to the Pilot Station at the foot of Pier A. The scanner on top of the tower is 4ft. wide, but this may be increased to an 8-ft. scanner if tests indicate that the larger scanner would be more satisfactory.

Port of Long Beach, California—continued

using the port, and the result of these surveys indicate that savings resulting from the elimination of vessel delays and the resultant standby time paid to stevedore gangs may run into thousands of dollars.

Inasmuch as this installation opens up a totally new field in the operation of ships in and out of a harbour, it is the intention of the port to proceed cautiously and operate the equipment for some time on an experimental basis. However, engineers and shippers alike are confident that it will prove to be entirely successful, and the new navigational aid will, within a relatively short period of time, be regarded as an integral and necessary adjunct of any modern port.

The Future

The ultimate port development programme in the harbour district as now planned, including the filling of additional land areas, will cost approximately $80,000,000 to $100,000,000 and will require 20 to 25 years to complete. Despite this large public investment, it is anticipated that the port will remain debt-free and that the programme will be completed without the necessity of bond issues or any taxation, the funds therefore to be derived from income accruing to the port from oil wells on Harbour Department property.

One of the major projects is the creation of a further extension to the Outer Harbour, to be known as the South-east Basin. This extension will furnish the Port of Long Beach with an additional 512 acres of artificially filled land, which in all probability will ultimately be further increased. The creation of such land areas not only provides additional port facilities, but will also provide the necessary sites for oil wells to properly develop the oil field. Provision will be made for a minimum of 44 large ship berths, 16 additional transit sheds, 12 warehouses, and large areas of ship-side open storage space. This basin is being constructed to compensate for the loss of port area turned over to the United States Navy for their construction of the Naval Base. The South-east Basin will accommodate a great variety of functions incidental to the port due to its great distance from the original shore and its close proximity to the open sea, and it will furnish sites for many of the important uses incident to any completed port.

In the Inner Harbour area important expenditures are planned for perfecting the highway approaches by which commercial traffic gains ingress and egress to the port.

All future projects are first tested on a detailed scale model of the port, which is located at the U.S. Waterways Experimental Station at Vicksburg, Mississippi. For a cost of approximately $30,000, a model of the port constructed by the engineers at the Waterways Experiment Station is being thoroughly tested for storm and surge conditions and the result in savings may run into millions of dollars. The ultimate effects of the projection of any breakwater, pier or other facility into the sea can be studied within a very few weeks, and any unforeseen damages which might result therefrom, such as silting, erosion and the like, can be prevented.

The Economics of Timber Substitution

Review of a Booklet and Pamphlets issued by the Timber Development Association Limited

Until recently, timber held a unique position as a vital commodity for ensuring cheap and economical production of goods in general. This arose from one basic cause, that in relation to competitive materials, timber was not only cheaper, but better and more suitable over a very wide range of our industrial needs.

Softwood timber has been in short supply in the United Kingdom since the commencement of the recent war, and all kinds of substitutes have had to be brought into use to make up for the shortage, most of which are more costly and less adaptable. The timber trade itself co-operated with the Government during the War by staffing a special department of the Timber Control to reduce timber specifications and to suggest substitutes, however costly this enforced policy might be.

The position now has changed inasmuch as sufficient supplies of softwood have again become available, in the various countries of origin, to supply all demands.

The necessity for a cheap and adequate supply of timber for the use of competitive industry both on the export and home side is even more urgent than it was in the 1930's. The Timber Development Association has been engaged in research and investigation with regard to the proper and economical utilisation of timber and has produced a booklet entitled " The Economics of Timber Substitution," which, with a memorandum drawing attention to the situation generally in respect to timber supplies, and suggesting ways in which timber imports could be increased without increasing the draw on the country's dollar resources, is now being studied by the Board of Trade.

The Association claims that its approach to the question of timber supplies and usages recognises how closely the prosperity of its industry is bound up with the wider one of the general well-being of the nation, and asks for nothing more than that the case they have put forward should be examined in that spirit.

The Economic Survey for 1949 forecasts that the imports of all raw materials will be 90 per cent. of the 1939 figure. Against this, the import of sawn softwood is estimated at only 60 per cent., that is to say 30 per cent. below the general average, which suggests that other raw materials are being given preference over softwood.

There may be several reasons for the curtailment of imports of timber, and in advancing their claim for a square deal for timber, the Timber Development Association examines many reasons for the preference which we, as a nation, show for other materials at the expense of timber.

It is stated that the first possible reason is that the timber does not exist in sufficient quantity; this however is easily disposed of, for it is estimated that one-fifth of the earth's surface is still covered by forests, by trees that are growing continuously. The Food and Agricultural Organisation of the United Nations, estimates that the world output of wood for 1948 equalled or slightly exceeded the pre-war average, and that owing to the decline in urgency of demands for timber, North American stocks have now reached normal levels. Canada, in particular is seriously concerned at the curtailment of her timber trade with this country.

The second possible reason is that we do not need the timber. This situation was debated in great detail at a conference of all the main timber-using industries held last March and established beyond all doubt that the lack of supplies was retarding production and constituted a serious threat to the Government's policy of full employment. Industrial consumption of raw materials is increasing, and if the timber-using industries are to hold their proper place in the structure and development of British industry, timber consumption must be increased to keep pace with the general increase in productivity.

The third possible reason is that it may be more profitable to use and import substitutes for timber rather than import the timber itself. The main materials that might be used in this way are steel, aluminium and Portland cement.

It is realised that steel production is an essential and growing part of Britain's economy, and that every bilateral trade agreement involves an obligation to export steel in one form or another. In spite of the importance of steel for export, however, we use a considerable quantity for the purpose of saving timber in our domestic programmes, and it has been suggested that if the steel now being used as a substitute for timber, were exported in manufactured form, it would earn sufficient currency to pay for anything from four to ten times the amount of timber which it is at present displacing.

Aluminium alloy also has been used as a substitute for timber, and approximately four-fifths of Britain's imported virgin aluminium comes from Canada who, as already stated, is anxious to also sell us the products of her forests. The aluminium costs the

Economics of Timber Substitution—continued

United Kingdom four times as much in dollars as would have been the case if timber had been used.

A contributory reason for the present shortage of cement is the very great effort made to extend the use of pre-stressed concrete as a substitute for timber. This is a very extravagant remedy, and it is significant that, until recently, the Portland cement used in the manufacture of reinforced concrete was almost entirely home produced, but last year it was considered necessary to import cement from the Continent.

The fourth possible reason for curtailment of timber supplies is that we are unable to pay for them. Although this may be true in the case of the Western hemisphere where dollars are needed, so far as sterling is concerned, there does not appear to be any difficulty.

The Timber Development Association in the memorandum to the Board of Trade suggested a policy which was broadly that we should conserve our steel and aluminium for export and that timber should be regarded as a raw material, which, properly used would increase our exports to such an extent as to pay not only for our increased purchases of timber, but would show a handsome profit which could be usefully expended in other directions. The present fiscal position, however, divides the world into dollar and sterling areas and so makes Sweden and Finland our chief sources of timber supply; this is causing a great deal of bitterness and inconvenience in other countries, which it is considered could be alleviated by a more far-sighted policy.

Statistical figures are quoted in the booklet in support of the Association's arguments and suggestions and some instances are given where the substitute for timber is shown to be uneconomic or has, in other ways, proved its technical unsuitability.

It is further stated that the use of substitute materials is one of the important contributory causes of increased building costs, which has a marked effect upon the cost of living and therefore indirectly upon production costs.

The booklet concludes with a list of over 100 applications in which other materials have been substituted for timber, contending that in a number of cases their use is both uneconomic and unsuitable.

The National Dock Labour Board

Excerpts from First Annual Report for the period from 28th June, 1947 to 3rd January, 1948

The Dock Workers (Regulation of Employment) Act became law on the 14th February, 1946. The Act provided, among other things, that a Scheme might be prepared jointly by bodies representative of dock workers and employers, but that if by October, 1946, no Scheme was in force, then the Minister was empowered to prepare a Scheme on the joint application of both sides of the industry.

The National Association of Port Employers and the Transport and General Workers Union and the Unions associated with it failed to agree a joint Scheme. In July, 1946, they thereupon submitted to the Minister of Labour their differing proposals for Dock Labour Schemes and jointly asked the Minister to prepare a Scheme.

In accordance with the procedure laid down in the Schedule to the Act, the Minister appointed Sir John Forster, K.C., to hold an inquiry, the findings of which were issued on 21st November, 1946, and the Minister proceeded to the drafting of the Scheme.

The draft Dock Workers (Regulation of Employment) Order, which embodied the Minister's Scheme, was issued in March, 1947; it required the Scheme to be operative in the ports scheduled therein by 28th June, 1947—except in Clydeside and Merseyside ports where, for technical reasons, the operative date was to be 30th June, 1947.

But the Act made provision for objections to the draft Scheme to be received during, at least, forty days from the making of the Order and required the Minister to cause " enquiries to be made " —unless the objections were withdrawn—and only thereafter make the Order. There were many objections. The Minister appointed Mr. John Cameron, D.S.C., K.C., to hold the enquiry and his report which examined, in great detail, the " objections " to the Scheme and made proposals for amending the Minister's draft Scheme, was issued on 31st May, 1947.

It was the 16th June, 1947, before the Order (and the Scheme) was made by the Minister and the Scheme was due to be in operation by the end of that month, under a new body—yet to be set up—the National Dock Labour Board.

The new Scheme differed from the former Dock Labour Schemes in many important respects, and the transition to the new Scheme was made more difficult because of the fundamental differences between the former Schemes administered on Clydeside and Merseyside by the Ministry of Transport, and those in the other ports under The National Dock Labour Corporation, Ltd.

The Basis of the New Scheme

The ports to which the Scheme relates were regrouped by the National Board into twenty-two areas each administered by a Local Board.

Dock work and dock workers to which the Scheme applies were defined as " the same classes or descriptions of dock work and dock workers as immediately before the coming into operation of the Schemes were included but subject to any exclusions or exceptions, whether general or particular, provided in dock labour schemes and the Port Registration Scheme." This definition presented little difficulty in ports where dock work had been previously defined in connection with the Dock Labour (Compulsory Registration) Order, 1940; but in Glasgow, where no definition existed, serious problems arose which have not yet been resolved. In certain other ports, the existing definitions were revised by local agreement—in particular, in ex-Ministry Ports where weekly workers were brought under a Scheme for the first time.

After formal notice had been given by the National Board, as required under Clause 7 of the Scheme, all employers and contractors registered or approved under Dock Labour Schemes when the 1947 Order came into force were included in the Employers' Register. Some 1,500 employers were so registered. Similarly, all workers on the Register or Record of Dock Labour Schemes at that time were included in the Register of Dock Workers.

The Scheme was devised and set up in full consultation with employers and workers; it is now part of the structure of the docks industry—but it is only a part. The Board acts on behalf of the industry and is its paying agent; it pays, on behalf of the employer wages earned in accordance with industrial agreements; it pays from its own funds holiday pay, travel time allowances and other transfer costs at rates and on conditions laid down by industrial agreements; the amount of the guaranteed wage and attendance money is fixed " under the terms of any agreement for that purpose come to from time to time by the National Joint Council for the Port Transport Industry or, failing such agreement, under any determination from time to time reached in such matter as the Minister may approve.

The National Dock Agreement of July, 1947, fixed the amount of the payments to be made to daily workers in respect of unemployment or under-employment, for the purposes of Clause 14 (1) of the Scheme. Attendance Money was fixed at 5s. per turn, with rates of guaranteed weekly payments differing according to age and grouping up to a maximum of 88s. for able-bodied men under 65 years of age.

Week-end earnings were excluded from earnings counted against the guaranteed weekly payments and this inevitably involved both employers and the Board in additional work and increased costs.

It was impracticable to operate this Agreement at the commencement of the Scheme, and with the concurrence of the National Joint

National Dock Labour Board—continued

Council its introduction was deferred until the 11th August, 1947.

Wages during employment were regulated by the National Dock Agreement of the 21st December, 1945, and the payment for annual and public holidays was fixed by the same agreement.

Administration of the Scheme

It will be clear from the sequence of events leading to the setting-up of the National Dock Labour Board that, in spite of the valuable preliminary work of the Working Committee, a large number of urgent administrative decisions faced the members of the new Board. A new administration had to be created to replace the interim arrangements carried over from former Dock Labour Schemes. It was necessary to appoint members of Local Boards and to determine their functions by the 1st October, 1947, to take over the work of Registration Committees and the administration of Appeal Tribunals, to review the administrative and accounting arrangements, to provide, by the 11th August 1947, for the operation of the new Agreement in respect of Attendance Money and Guaranteed Weekly payments and to define the groups into which men were to be divided for this purpose: At the same time, the ports were extremely busy and there were numerous and varied labour problems requiring attention. In fact, the Scheme was in operation before the new administration could be set up. It will be appreciated that the Board, though working against time throughout this period, had to make its decisions and plan for a permanent organisation, and at the same time avoid any improvisation which, however attractive as offering some immediate solution, might establish an unfortunate precedent for the future.

In accordance with the Scheme and the intentions of the Industry, the National Board decentralised the administration of the Scheme to the fullest extent possible. The Board looked to the Local Boards to advise as to how the objects of the Scheme might be fulfilled and, in particular, how best to secure the greatest regularity of employment by the proper use of labour and efficient administration.

The size of the Labour Force was one of the matters on which the final decision was reserved to the National Board, though the fullest consultation with Local Boards has been sought before any decision has been reached. The registration of workers formerly undertaken, with few exceptions, by Joint Committees now devolved on Local Boards which, in some areas, set up committees for this purpose.

The Ministry of Labour had been responsible for the payment of dockers' wages in Liverpool ever since the Clearing House Scheme was inaugurated in 1912. Since 1941 it had acted as Accounting Agents of the Ministry of Transport Schemes, both in Liverpool and Glasgow, but asked to be relieved of its commitments not later than April, 1948. Further, the Port of London Authority had requested that its agency should be terminated at a date to be mutually agreed. The Board accordingly gave priority to establishing its own accounting organisation in these ports. By the end of the year the change-over had been effected on Clydeside and plans were well advanced in respect of Merseyside; and the Corporation's proposals for a Hollerith installation in London were reviewed and adopted. In addition, and with the concurrence of Accounting Agents at Aberdeen, Dundee and Leith, preliminary plans had been made for an area accounting organisation based on Leith and covering the whole of East Scotland.

Composition of the Labour Force

At the changeover the Board had 78,458 men on the Registers; at the end of the year the total had increased to 79,769. An analysis of the Register at the end of the year is as follows:—

Dockers:	
Tyne and Wear	1,755
Middlesbrough and Hartlepools	1,782
Hull and Goole	4,587
Grimsby and Immingham	1,024
East Anglia	724
London	28,091
Medway and Swale	252
South Coast	2,185
Plymouth	242
Cornwall	320
Bristol and Severn	2,742
South Wales	2,674
Liverpool	18,506
Manchester	3,259
Preston	397
Fleetwood	131
Barrow	93
Cumberland	116
Ayrshire	145
Greenock	451
Glasgow	3,472
East Scotland	2,535
	75,483
Coal Trimmers:	
Tyne and Wear	596
Middlesbrough and Hartlepools	110
Grimsby and Immingham	164
South Wales	808
Cumberland	101
Ayrshire	99
East Scotland	229
	2,107
Fish Dock Workers:	
Grimsby	1,248
Fleetwood	420
Aberdeen	372
	2,040
Riggers (South Wales)	139
Workers' Register	79,769

Shipping Delays

Delays in the turn-round of shipping were of serious concern, but they did not, of course, always arise from labour shortages. Lack of berthage or wagons, shortage of key personnel or congestion of quays, the non-arrival of cargo or inadequate facilities were only a few of the contributory factors on which the Board submitted weekly reports to the Ministry of Transport. Eventually, in September, 1947, the Minister set up a Working Party—

> " to consider measures likely to give speedy results in improved turn-round of ships in the United Kingdom ports and to initiate action or suggest methods by which improvement could be achieved."

The Board was represented on the Working Party by its General Manager and, during the period under review, its enquiries covered the Ports of Tyne and Tees, Hull, London, Bristol, South Wales and Liverpool.

There were delays, of course, due entirely to a shortage of labour and this was a matter of concern, both to the National Board and the National Joint Council. On the one hand it was an obligation on the Board to provide adequate and efficient labour; on the other hand, frequent adjustment of the size of local Registers to meet temporary fluctuations in trade, by recruitment or dismissal, was obviously undesirable and not in accord with the Scheme.

Almost at the same time as the Board was established the economic situation of the country had been the subject of statements by the Government indicating serious cuts in imports, the incidence of which could not be foreseen. In laying the foundation of its labour policy, therefore, the Board could not afford to leave these national considerations out of account. Accordingly after consultation with the Ministry of Transport and the National Joint

National Dock Labour Board—continued

Council, the Board decided in September to limit the replacement of natural wastage to ports where this appeared to be justified, and to examine all applications from Local Boards for additional recruitment in the light not only of current needs but of future prospects.

On the major issue, however, of temporary peaks and labour shortages, with consequent delays to shipping, the Board found itself in agreement with the National Joint Council in deciding, as a matter of policy, that the Board should maintain a labour force which, augmented if need be by transferred labour, should be sufficient to meet normal requirements; but, at the same time, being aware that there may be occasional excessive and temporary peaks for which the Scheme should not be expected to carry continuing surplus labour, and for which the employment of non-registered labour under Clause 10 (3) of the Scheme was intended.

Low Rate of Absenteeism

A most satisfactory feature of the labour returns for the period is the low percentage (2.1%) " Not accounted for." This is primarily a balancing figure, being the difference between the numbers whose whereabouts are known at each call time (i.e., at work, proving attendance, sick, etc.), and the total number of men on the Register. Subsequently, some of these men " not accounted for " produced valid reasons why they were absent at that Call; but they were included in the total " not accounted for " at the morning count and hence, the figure of 2.1% is in excess of the percentage of actual absentees. This is a most creditable position —and particularly so in an industry previously based primarily on casual labour—and compares most favourably with returns available for any other industry.

Welfare Development Programme

The Scheme lays an obligation upon the Board to make—

" satisfactory provision for the training and welfare of dock workers, including port medical services, in so far as such provision does not exist apart from the Scheme."

The Board was fortunate that it was able to commence the development of its Welfare Programme on the basis of the previous valuable work undertaken by the administrators of the earlier Schemes.

The National Dock Labour Corporation Limited had agreed with the National Joint Council, a Statement of Principles for the development of Welfare and Port Medical Services which was subsequently accepted by the Board. Considerable progress had been achieved and a number of Welfare Officers appointed whose work in the ports had evoked a co-operative response from both employers and men.

Although the Corporation had been prevented until 1945 from setting up Port Medical Centres, the Directors of the Corporation had encouraged Local Boards to prepare Port Medical Schemes suitable for the locality; and had set aside monies to implement these Schemes. Thus, in this major field of Welfare, the National Board inherited well prepared plans and the monies with which to finance them.

On the Merseyside and Clydeside the Ministry of Transport had developed extensively a Port Medical Service which had proved of great value to the industry during the stress of war. The Board is deeply appreciative of the work of the Mersey Docks and Harbour Board, and of the Clyde Navigation Trust, which had been responsible to the Minister of Transport for the initiation, development and administration of these Port Medical Schemes and of the generous and co-operative way in which they made available their experience, equipment and trained staff to the Board.

Earnings of Daily Workers

The average weekly earnings of daily workers, that is monies received from all sources, for the 27 weeks ended the 3rd January, was £7 18s. 4d. During this period there was a higher volume of employment than may be regarded as normal. Nevertheless, there were considerable fluctuations in earning from week to week. It is interesting to note that the gross turnover in earnings of daily workers alone exceeded £13 million, or just over £480,000 per week. Employers of Weekly Workers paid, during the same period, a weekly average of £81,500 in gross wages, making the total gross earnings of all registered workers in the neighbourhood of £560,000 a week.

Financial Accounts for the Period

The Board's accounts for the period from 28th June, 1947, to 3rd January, 1948, show that

	£	£
The excess of income over expenditure was,		563,638
from which appropriations were made to ..		
General Reserve Fund	358,285	
Welfare Fund	16,500	
		374,785
leaving a balance to 3rd January, 1948, of		£188,853

The rates of percentage payments operative under previous Schemes, viz.: 15% on the wages of daily workers and 10% on the wages of weekly workers, were continued by the Board and remained unchanged throughout the six months under review.

The Board recognised that frequent changes in the rates of percentage payments would seriously inconvenience employers generally but might be difficult to avoid—because of the violent fluctuations in employment to which the Industry is subject—unless adequate reserves were built up as quickly as possible. To this end and to provide for other contingencies, it was decided to establish a General Reserve Fund and to appropriate from current revenue sums equivalent to a levy of 2½% on the wages of all registered workers. As a result of this decision accruals to the General Reserve Fund (including interest) for the six months to 3rd January amounted to £358,554, all of which has since been invested in gilt-edged securities. The Board further decided that appropriations to the Fund should continue until a sum of not less than £1 million had been accumulated, and that any steps necessary to maintain or increase this Reserve should be decided in the light of experience.

The finances of a Dock Labour Scheme are obviously subject to a " scissor " movement. When the volume of employment is high, the costs of Attendance Money and Guarantee are low and the Board's income rises; but when the volume of employment declines, the standing and administrative charges remain constant, the cost of Attendance Money and Guarantee Make-up increases and, at the same time, income declines sharply. Within a very short time, what might have been regarded as an ample reserve may quickly be absorbed.

General Conclusions

It would be obviously unwise to generalise on the basis of six months' experience. The Board has been able, however, from its own experience and that of its predecessors, to note the emergence of certain labour and financial problems on which decisions have been taken as indicated in this Report which, it is hoped, will prove to be the foundations of a continuing policy. But for the moment the Board has been content to deal with such matters so as to secure, as best it may, an immediate resolution of the difficulties, yet at the same time having in mind the permanence of the Scheme and the need for a long term policy.

The Board's greatest difficulty was, and continues to be, lack of adequate information as to future labour requirements. It has had to plan on the basis of past experience—a most unreliable basis in present changing conditions. The Board will continue to press that it should be given such relevant forecasts from Government Departments and industrialists on trade developments as may be available, even though such information must be treated with the greatest reserve. When considering such forecasts, the Board must also have regard to changes in the manner of shipment and handling in the Industry as affecting man-power and the very many physical facts which influence differing port conditions and methods of working.

However complex may be the problems of the Industry, it is clear that the setting-up of the 22 Local Boards has focused extremely valuable local experience which will help materially in establishing the Dock Labour Scheme on a sound practical basis.

Concrete Pile Manufacture

Report on Work carried out at the Port of Launceston, Tasmania

By ALLAN BENNETT, B.C.E., M.E. (Member)*

City and Port of Launceston

THE City of Launceston is situated at the confluence of the North and South Esk, which form the tidal Tamar River, at a point some 41 miles from the coast. This location is a natural focal point for the state, it is the centre of both the railway and roadway systems, and is adjacent to a good aerodrome at Western Junction.

The Tamar River is tidal, with an average rise and fall at Launceston of 10-ft. 8-in. By working the tides, it is possible to bring vessels drawing a maximum of 20-ft. right up to the city, and Launceston acts as a distributing centre for the major portion of Tasmania. At Launceston, the principal wharf, Kings Wharf, is located in Home Reach, immediately adjacent to the city, with both road and rail access. The wharf, which is mainly constructed of local timber, is 1,650 feet long and is equipped with three transit sheds.

To deal with overseas shipping of greater draft, there are three jetties in the lower Tamar, Beauty Point, and Inspection Head jetties on the west side and Bell Bay jetty on the east side. These jetties provide a total frontage of 1,260 lin. ft., but as they are not connected to the railway system, their use is definitely limited. The depth of water available varies from 30 to 40 feet and the largest ships afloat can be accommodated. All the jetties are constructed of timber and all are provided with sheds.

Condition of Wharves

The condition of the wharves generally was very bad. With the exception of a short section (272 feet of concrete construction), the remaining timber wharves were in urgent need of renewal. The Marine Board had functioned for nearly twenty years without a qualified harbour engineer, relying for professional advice on the spasmodic employment of consulting engineers, consequently intelligent planning of development and continuous supervision of maintenance had been lacking and the Board consequently found itself faced with large arrears of work, as well as an urgent necessity for expansion.

Population

Investigations show that Launceston, both as to its population and its trade, has steadily progressed in the past, notwithstanding the apathy towards port facilities, and with the inauguration of a progressive policy by the present Board is likely to develop still more rapidly in the future.

The total city and suburban population is now estimated at 40,499. Prior to the war the increase averaged 15.75% per decade; of later years the increase has been at the rate of 19.5% per decade.

It is, of course, absurd to try and predict exactly the future increase of population. With various projected industrial developments, it is quite possible that the population increase may be much greater than the latter rate; in any case, there are sufficient grounds for an optimistic outlook for the future of Launceston.

Trade Statistics

Trade statistics are issued annually by the Government Statistician. The latest returns available are for 1946-47 and the trade figures for Tasmanian ports show that Launceston port handles 32.9% by value of the trade of the island. As these figures do not include coastwise trade which centres on Launceston and which totalled 17,814 tons for the year, the port actually handles a much bigger proportion of the total trade. It is also to be noted that the unit value of Launceston trade (£48.9 per ton) is well above the State average of £29 per ton.

From the same source of statistics, it is found that the volume of trade has practically doubled from 1924 to the present time, and that the proportion of the total volume of trade of Tasmania has increased from 15% to nearly 20%.

Another interesting figure is the volume of trade per head of population. This rose from 6 tons per head per annum in 1924 to 7½ tons per head per annum in 1947—an increase of 25%. Using this figure in conjunction with the forecast of population, an estimate was made showing the probable future trade of the port.

*Paper read before a General Meeting of the Tasmania Division of The Institution of Engineers, Australia, on 27th July, 1948, and reproduced by kind permission.

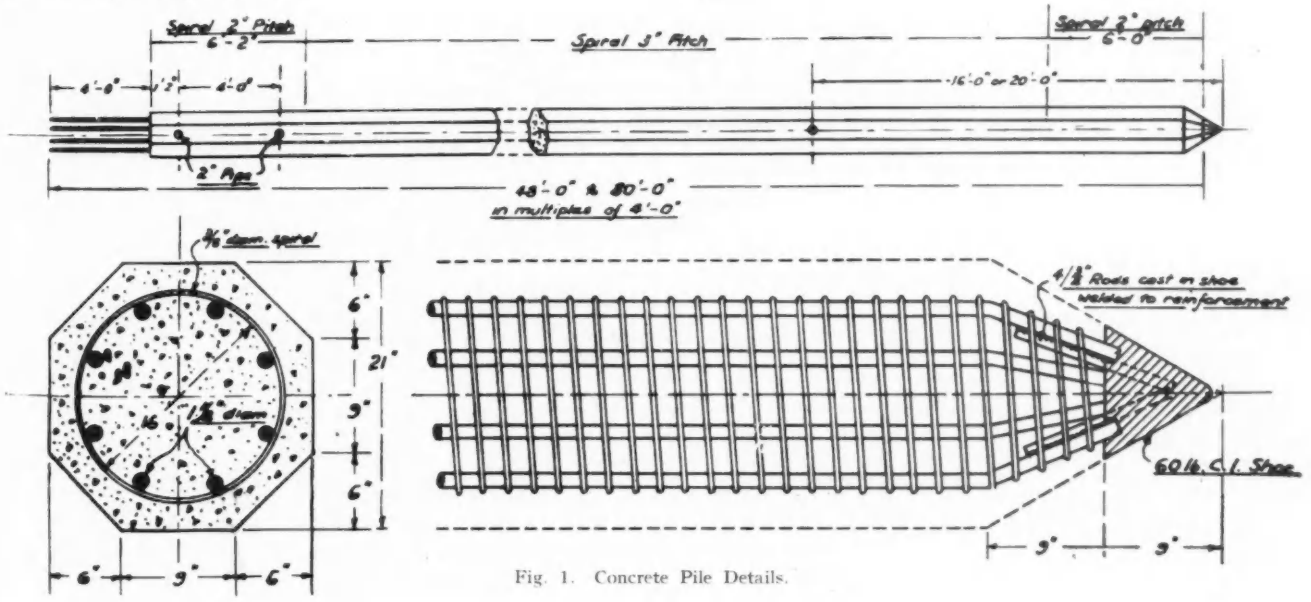


Fig. 1. Concrete Pile Details.

Concrete Pile Manufacture—continued

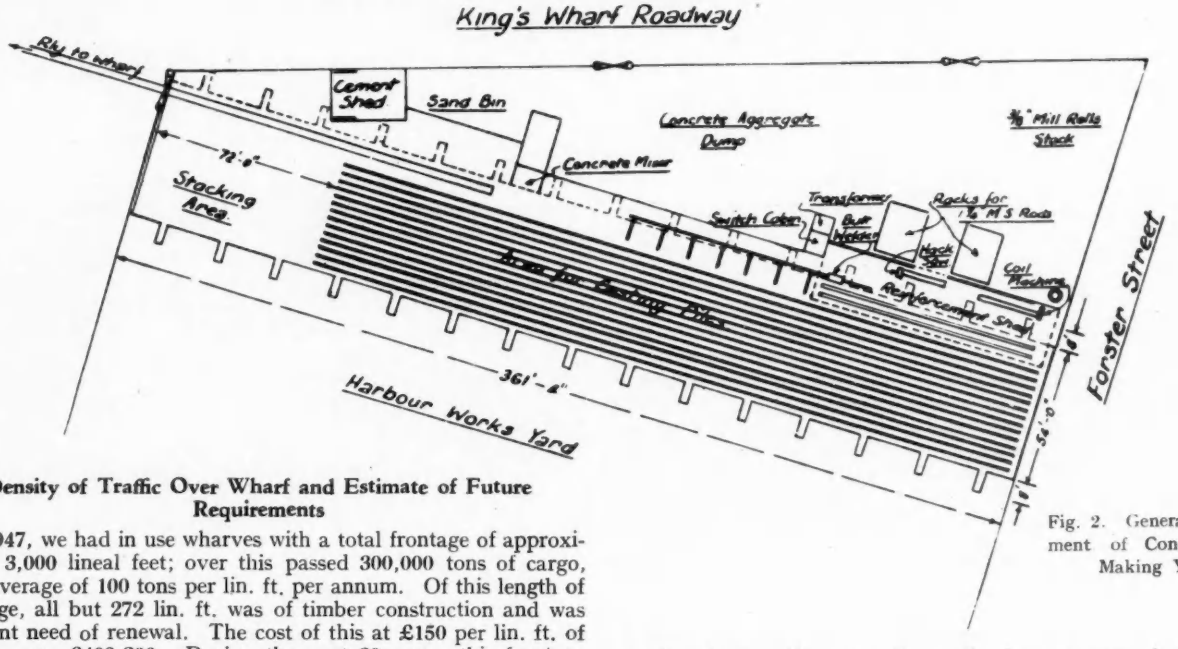


Fig. 2. General Arrangement of Concrete Pile Making Yard.

Density of Traffic Over Wharf and Estimate of Future Requirements

In 1947, we had in use wharves with a total frontage of approximately 3,000 lineal feet; over this passed 300,000 tons of cargo, or an average of 100 tons per lin. ft. per annum. Of this length of wharfage, all but 272 lin. ft. was of timber construction and was in urgent need of renewal. The cost of this at £150 per lin. ft. of frontage was £409,200. During the next 20 years, this frontage will have to be extended a further 1,200 ft. at a cost of, say, £180,000, or a total of £589,200. Roughly speaking, the Board is faced with a total expenditure of approximately £600,000 for wharf construction, and to this must be added the costs of transit sheds and mechanical appliances for handling cargo. The total cost of rehabilitating the port will be about £1,000,000.

Selection of Type of Wharf

The level ground adjoining the water front at Launceston consists of some 50 to 70 feet of silt overlying a bed of soft stone. The bearing value of this ground is very low, a load of 2½ cwt. per sq. ft. producing a compression of one inch at the best. The river banks have stabilised themselves at an angle of 15°. Once, however, the surface crust is broken, the ground has practically no strength whatsoever—timber piles of their own weight readily penetrate 20 to 30 feet. All piles, therefore, have to be driven until they reach a firm bottom on rock.

Stringy bark piles are readily obtainable at a price about 3s. per lin. foot. However, these piles have a very short life; at Launceston this can be put at about 20 years, when the heads are eaten out with dry rot; in the lower Tamar, marine worms will completely eat a pile in 10 years. Because of dry rot, the life of a timber superstructure can also be taken at not more than 20 years. The demand, too, for timber for housing purposes is so great, that it is exceedingly difficult to get timber in large sizes for wharf work in sufficient quantity or of good quality. Stringy bark timber is not very suitable for decking, it shrinks badly, is readily splintered, and under any volume of traffic soon presents a bad surface.

By these circumstances, therefore, the Board has been forced to adopt reinforced concrete construction for its wharves.

Reinforced Concrete Piling

The lengths of piles that were required varied from a minimum of 48 feet to a maximum of 80 feet. For economy of construction, it was decided to adopt a standard section for all lengths of piles, consisting of an octagonal section 21 inches between flats reinforced

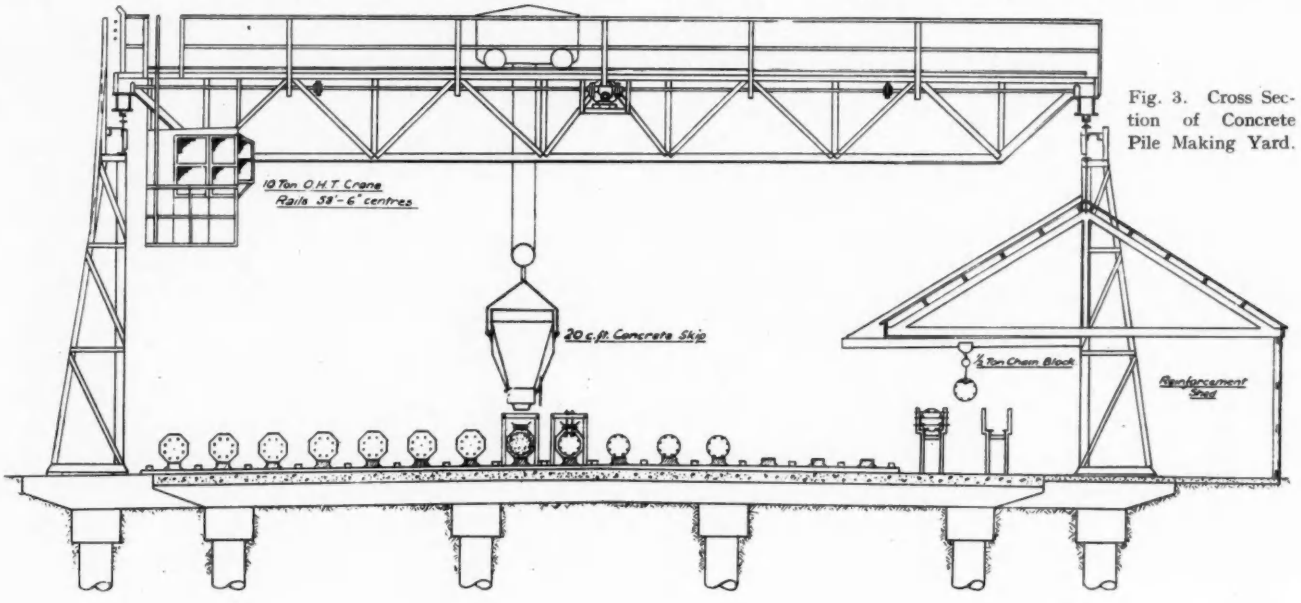


Fig. 3. Cross Section of Concrete Pile Making Yard.

Concrete Pile Manufacture—continued

with only eight 1¼-inch longitudinal round mild steel rods with spiral reinforcement of three-eighth mild steel, 16-inches internal diameter, with a pitch of 3-inches closing to 2-inches for 6-feet from each end of the pile (Fig. No. 1). The concrete mix was a nominal seven bags cement to one cubic yard of aggregate.

General View of Concrete Pile Making Yard.

Similar piles to these have been in use at Fremantle for 25 years, and as a matter of interest a comparison is given:—

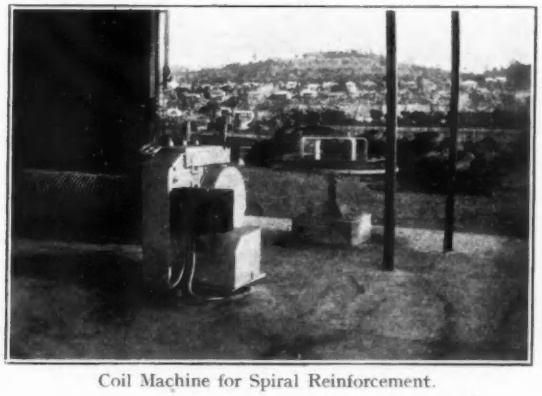
	Fremantle.	Launceston.
Width between flats (inches)	17	21
Maximum length (feet)	60	80
Slenderness ratio	42.4	45.7
Longitudinal reinforcement diameter in inches	1	1.25
% of longitudinal reinforcement to gross area	2.63	2.66

Circumferential Reinforcement:—

	Fremantle.	Launceston.
Diameter of reinforcement (inches)	0.375	0.375
Diameter of cone (inches)	12	16
Pitch of spiral (inches)	1½ to 2	2 to 3
% Spiral reinforcement to cone volume	2.37 to 1.84	1.38 to 0.92

It will be noticed that the designs are very similar, with the one exception that the % of spiral reinforcement has been reduced to conform with modern practice, which is to provide approximately 3% of longitudinal reinforcement on gross area, and 1% of spiral reinforcement on core volume.

To provide for lifting the pile, 2-inch diam. pipes are cast in appropriate positions to take 1⅞-inch diam. nickel steel bolts.



Coil Machine for Spiral Reinforcement.

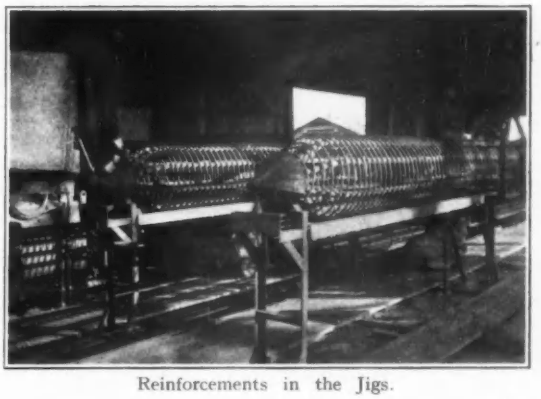
Concrete Pile Yard

As we were faced with an immediate demand for some 2,000 piles, and as there was every prospect of continuing future demands, it was decided to construct a special yard for making concrete piles.

Immediately adjacent to Kings Wharf the Board owned an area of land 360 feet long, and this was selected as the site. As the ground had a very low bearing strength, a piled foundation was adopted, supporting a concrete floor. The following are the principles underlying the design of the yard:—

(1) Output of yard to be four piles per day.
(2) Piles to lie three weeks before being stacked. This meant that an area sufficient to hold 60 piles had to be set aside for casting.
(3) Piles to be driven six weeks after casting. This meant that a stacking area had to be provided for 60 piles.
(4) The yard to be worked with overhead travelling cranes. It was decided to make the span of the cranes short enough to fit inside the wharf sheds, so 58-ft. 6-in. was adopted.
(5) The maximum length of pile for down the river was estimated at 80-ft. However, the main work at Kings Wharf needed a maximum length of 72-ft., with an average length of 64-ft.
(6) Steel shuttering was adopted as it provided a true shape and better finish for the pile. It did not absorb water, thus maintaining the strength of the concrete and did not shrink and twist with age. It also lent itself to unit construction.
(7) The reinforcement to be electric welded together, the longitudinal rods being flash butt welded, and the spiral reinforcement arc welded.
(8) Provision to be made for rail delivery of cement, and also for transport of piles to the job.

The general arrangement adopted is shown in Fig. No. 2 and the cross-section in Fig. No. 3, various components being as follows:—



Reinforcements in the Jigs.

1.—Concrete Floor.—The floor is 360 feet long and is designed to carry a gantry for two 10-ton overhead travelling cranes of 58-ft. 6-in. span and a uniform load of 3 cwt. per sq. ft. It is supported by timber piles at 12-ft. centres and is 8-in. thick.

2.—Steel Gantry.—The gantry follows the conventional "A" frame design, the beams span 24-ft. and are of 24-in. × 7½-in. R.S.J.'s stiffened with a 10-in. × 3½-in. channel. The actual sizes adopted were dictated by the structural shapes available. Provision was made for the down shop leads to be carried above rail level.

3.—Overhead Travelling Cranes.—The cranes were designed so that they could in the future fit inside a wharf shed; this fixed the span at 58-ft. 6-in. The height of the crane was made as low as possible, 6-ft. 11-in. above rail level to clear principals, and down shop leads were carried above rail level so that in the shed they would clear the door tracks. The capacity of the crane was fixed at 10 tons, and it was specified that it would carry for testing purposes 25% over the rated loading. Speeds for which the crane is designed are as follows:—

Hoist	30 feet per minute.
Traverse	80 ,, ,, ,,
Longitudinal travel	260 ,, ,, ,,

Worm drive in lieu of the usual gear drive was adopted, as it gave a much smoother and quieter action. The function of the cranes is threefold:—

Concrete Pile Manufacture—continued

(a) To transport the manufactured reinforcement to the pile mould.
(b) To transport the mixed concrete in a skip to the mould.
(c) To transport the piles to the stacking area, and to load them on rail for transport to the job.

4.—Reinforcement Shed.—This shed housed the following:—

(a) *Coil Winder.*—This winder was designed and built specially for the purpose of turning out coils for the reinforcement of the piles. It consisted essentially of two sets of rollers, the first set to straighten the $\frac{3}{8}$-in. wire supplied from the mill rolls, and the second set to curve it to 16-in. diam. and to give it a pitch of 3-in. The machine was powered with a 5 h.p. motor and produces a coil at the rate of 60 turns per minute. The coil was fed on to two revolving rollers, and cut off in the desired length. A reversing switch was fitted, and it was possible to uncoil a helix and take it out of the machine as a straight rod. The $\frac{3}{8}$-in. rod as supplied in mill rolls from Newcastle had a yield point of 50,000 lbs. per sq. in. and an ultimate strength of 80,000 lbs. After passing through the coil machine, the yield point was raised to 53,000 lbs. per sq. in. After manufacture the coils were placed on the jig for making pile reinforcements.

(b) *Flash Butt Welder.*—The longitudinal rods were $1\frac{1}{4}$-in. diam., supplied in 16-ft. lengths. Piles were made in multiples of 4-ft., the rods being cut to length in a hack-saw machine. By selecting correct lengths, it was possible to stagger the joints so that not more than three out of eight came together. The rods were welded together in a flash butt welder into one continuous rod the full length of the pile.

The flash butt welder used was a 36 K.V.A. machine, capable of butt welding sections up to 2.25 sq. ins. Using $1\frac{1}{4}$-in. rods, one man could weld sufficient rods for a pile in two hours; this corresponds to 64 welds and includes bending the end of 16 rods to fit into the C.I. pile shoe. Rollers were placed so that the rod moved easily in and out of the machine, and, on completion of welding, the rod moved into position through an opening in a vertical R.S.J. for a hydraulic jack to upset the end. The finished rod then rolled down an incline to rollers set opposite the pile reinforcement jigs.

(c) *Reinforcement Jigs.*—These were designed so that reinforcements could be made for piles 80 feet long. The spiral reinforcement was laid in coils along the table. Rods were then inserted through the jigs to hold the longitudinal rods at correct levels, afterwards being pulled through. Next the C.I. shoe was clamped into position and four of the rods welded to rods projecting from the shoe. The remaining rods were brought into position and diametrically opposite rods forced apart to correct distance with 2-in. × $\frac{3}{8}$-in. M.S. distance pieces. Next the coil was tightened upon the longitudinal rods and the whole tacked together by arc welding every fourth or fifth junction. On completion of manufacture, the distance pieces were knocked out and the jig rods withdrawn. The whole reinforcement was then lifted by chain blocks and run to the outside of the reinforcement shed, where the O.H.T. cranes took over the lift, using a lifting beam, and transferred the reinforcement to the pile mould.

Concrete Moulds.—The base consisted of 9-in. × 3-in. rolled steel channels welded together to form a continuous length of 288-ft. There were 15 of them mounted on wooden blocks at 4 feet intervals (Fig. No. 4).

The side moulds were folded out of $\frac{1}{8}$ M.S. plate in 8 foot lengths, clamped to the base mould by $\frac{3}{4}$-in. bolts at 4 foot centres passing through 3-in. × 3-in. hardwood. There were slotted holes in the side mould for these bolts.

At the junctions of the side moulds a wooden clamp was placed, and this was held tight against the moulds by fox wedges acting against a fixed block.

The reinforcement was held in position by hook bolts passing through the wooden clamps.

Special end moulds were made out of $\frac{1}{4}$-in. M.S. plate for the shoe and the head of the pile.

Altogether there were sufficient side and end moulds to set up six piles for casting. As the day's output was four piles, and as side moulds were stripped after 24 hours, the mould assembly was always kept two piles in advance of casting.

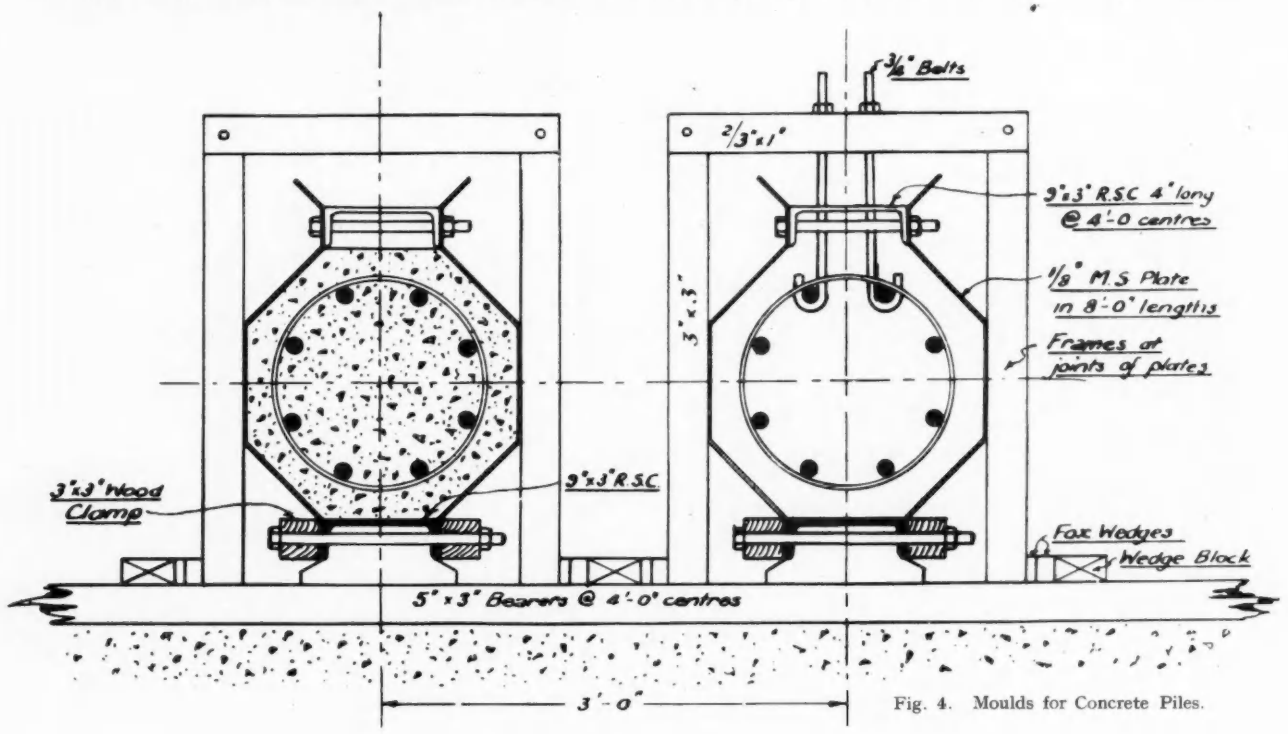
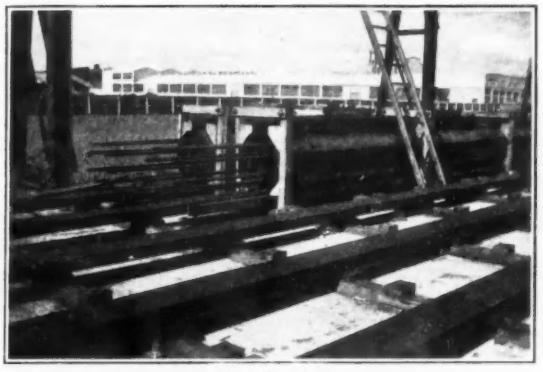


Fig. 4. Moulds for Concrete Piles.

Concrete Pile Manufacture—continued

A gang, consisting of a carpenter and four labourers, was sufficient to cope with all form work, including stripping, cleaning and setting up.

Concrete Mixing.—Concrete mixing was carried out with a 20 cub. ft. Britstand tilting drum concrete mixer. The mixer was mounted on a stand some 6 feet high.



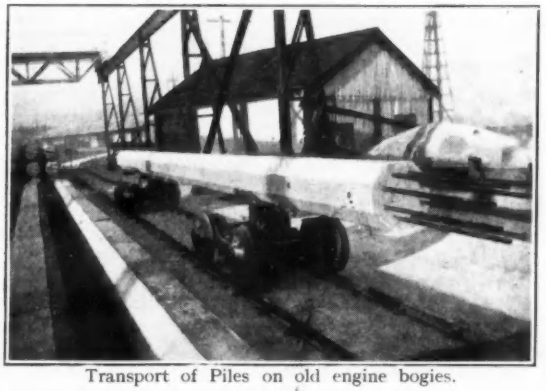
Pile Moulds.

The mixture adopted was a nominal 1 : 1½ : 3. The aggregate was crushed diabase passing ¾-in. and retained on ¼-in. screen, and was obtained from the City Council's quarry some four miles from the plant. A good quality sand was obtained from Deviot, some 21 miles distant. Extensive experiments for maximum density of mix gave the following proportions by volume, the sand being measured in a moist condition, 1 : 1.83 : 2.86. The materials were measured out in special gauging barrows to give these proportions. It was decided to adopt a slump of 2 inches, and it was found that 4 galls. of water to the bag of cement gave this figure.

However, since commencement of operations, the Council quarry ceased functioning, and recourse was had to a good quality quartzite gravel obtained from Beaconsfield. A mix of seven bags to the cubic yard was adopted, and it was found by test that the gravel concrete was actually stronger than that made with crushed metal. Compression tests gave the following figures:—

Compressive strength at 7 days ... 3,450 lbs. per sq. in.
,, ,, ,, 28 ,, ... 4,400 ,, ,, ,, ,,

After mixing, the batch was emptied into a concrete skip, which was transported to the pile mould by the overhead crane and discharged through a bottom door. The procedure was to centre the skip over the mould, and then to empty slowly as the crane travels the length of the mould. Casting was done in two or three layers and usually took 40 minutes per pile to complete.



Transport of Piles on old engine bogies.

During casting, vibration was effected by applying an Ingersol-Rand pneumatic scaler with a special hammer head to the outside of the M.S. forming.

After stripping the moulds, the piles were sprayed with concrete curing oil and then left for three weeks before stacking.

Stacking and Transport

After three weeks the piles were lifted by the two O.H.T. cranes and stacked in an area reserved at one end of the yard. Lifting was effected by using nickel steel bolts through 2-in. pipes cast in the piles. The floor was designed to carry a stack of piles three high, and there was room altogether for sixty piles, or the output of the yard for three weeks.

Transport of the piles to the pile driver was by rail. Two bogies from a condemned Garrott engine were purchased from the Railway Dept. and were fitted with a cradle to carry the pile. The bogies were placed at the fifth points of the pile, and the whole was pulled where required by a Fordson tractor.

Labour and Costs

The actual cost of establishing the yard was nearly £25,000, made up as follows:—

Concrete Pile Yard.	£	s.	d.
Clearing and filling site and fencing ...	2,320	14	9
Pile foundations	2,881	17	8
Concrete floor	5,656	15	3
Overhead Crane Gantry	3,084	13	0
Overhead Travelling Cranes	5,480	19	8
Welding and Cutting Plant	825	15	3
Pile Moulds	1,966	0	0
Reinforcement Shed and Jigs	1,042	15	6
Concrete Mixing Plant	955	16	5
Electric Installation	431	16	6
	£24,647	4	0

Allocation of Labour.

The yard was operated by 23 men, allocated to duties as follows:—

Yard foreman	1
Concrete mixing	5
Concrete placing	3
Mould assembling	5
Reinforcement assembling ...	8
O.H.T. crane	1
Total ...	23 men

Cost of Completed Piles.

Up to 30th June, 1948, the cost of manufacture of the piles per lin. ft. was as follows:—

	Labour.		Materials.		Total.	
	s.	d.	s.	d.	s.	d.
Reinforcements	1	9.78	5	8.37	7	6.15
Assembling moulds		11.04		—		11.04
Concreting	1	3.36	5	9.75	7	1.11
Handling and stacking ...		1.08		—		1.08
Totals ...	4	1.26	11	6.12	15	7.38

Labour costs represent 26.25% only of the total cost.

Putting the figures into more usual rates, we get the following:

Reinforcement per cwt. ...	Labour:	4s.	11.5d.
	Material:	15s.	7.5d.
	Total	£1	0s.	7.0d.
Concrete per cub. yd. ...	Labour:	£1	5s.	8d.
	Material:	£3	7s.	1d.
	Total	£4	12s.	9d.

From the preceding figures, it will be seen that the use of a properly designed pile yard has resulted in a considerable reduction of cost.

Checking these figures against an average of contract prices available for similar work in Tasmania, it is estimated that there will be a total reduction of costs of not less than £37 10s. 0d. per pile.

On a programme of driving 2,000 piles, the total saving would be £75,000 as against an initial cost for the plant of £25,000.

Obituary

Colonel W. E. Walker, C.B.E., T.D.

It is with great regret that we record the death on April 14th last of Colonel W. E. Walker, C.B.E., T.D., in Westminster Hospital at the age of 63.

After serving his apprenticeship at Woolwich Arsenal Col. Walker joined Sir W. G. Armstrong-Whitworth & Co., Ltd., at Elswick Works, Newcastle-on-Tyne. Called up for service in the Royal Artillery (T.A.) in August, 1914, he served in France in 1915 and was subsequently recalled for an appointment as Manager of the

The late Col. W. E. WALKER, C.B.E., T.D.

new Cartridge Case factories at Scotswood. In 1924 he went to Italy as General Manager of the Pozzuoli Works, and returned to Elswick in 1927 and became Manager of the Shell Department. In 1940, at the special request of Admiral Sir Harold Brown, he was lent to the Ministry of Supply by Vickers-Armstrongs, Ltd., as Director of Ammunition Production (Shell). He rejoined Vickers-Armstrongs at their London Office in 1945.

Colonel Walker had a distinguished career in the Territorial Army and served in the 72nd Brigade, Royal Artillery (T.A.) from 1910-1935. He was in command for the last six years of this period and was awarded the C.B.E. for his services.

After the recent War, Col. Walker became well known to the majority of Dock and Harbour Authorities as he was largely responsible in the Vickers-Armstrongs' organisation for numerous dock equipment contracts, including their installation. Amongst these was the installation of the caisson for the large graving dock at Le Havre and other similar work, including renewal of dock gates at Aberdeen, Portishead and Shoreham. Many other types of dock equipment also came under his control, and his passing will be noted with much regret by his many friends amongst the Dock Authorities.

The Institute of Transport.

The Council of the Institute of Transport has announced the election of the following officers for the year commencing October 1st, 1949:—President, Brigadier-General Sir H. Osborne Mance; vice-presidents, Mr. R. Davidson, Sir Robert Letch, Messrs. V. A. M. Robertson, A. B. B. Valentine, J. S. Wills and W. Donaldson Wright; hon. treasurer, Mr. S. Kennedy; hon. librarian, Mr. C. T. Brunner; past presidents to serve on the Council, Mr. R. Kelso, Sir Frederick Handley Page, Messrs. D. R. Lamb, R. Stuart Pilcher, T. W. Royle and Sir William Wood.

Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

INLAND WATERWAYS OF THE UNITED KINGDOM.

I have read in your May issue the report on the above Paper recently read by Mr. W. L. Ives, LL.B., A.M.Inst.T., before the Institute of Transport, and feel anxiety at his complacent attitude towards the very serious crisis confronting the canal industry to-day. I propose to illustrate my concern by means of questions based on Mr. Ives' statements.

Mr. Ives mentions town planners. What degree of co-ordination is there between town planners and the Docks and Inland Waterways Executive? Most town planners, even the more eminent ones, seem to be sublimely ignorant of the use and amenities of canals. In many cases, no doubt, this is because the use of a high level bridge would be involved, and this might interfere with the symmetry of their plans.

Coupled with town planning is the location of new electric power stations, all of which, Mr. Ives implies, are to have their coal delivered by canal. This, however, is not always to be the case. To take one example, that of Peterborough, the River Nene (which is fully navigable) is not to be used to bring coal to this vast new station. It is to be brought by rail, and the river bank is to be used for coal storage and wagon sidings. Similarly, the new power station at Meaford (Stoke-on-Trent), though it stands beside the Trent and Mersey Canal, has no facilities for receiving waterborne supplies. It is true, as Mr. Ives points out, that these stations may get their cooling water from the canal, but how is that supposed to help canal revival—especially when valuable water is taken at all times of the year, even during periods of drought?

Mr. Ives says that "an officer has been appointed with the object of making known the facilities that the Executive has to offer." With what success so far? How many new firms are using canal transport as a result of this publicity? Surely all those firms which are most likely to use canal transport by the nature of their raw materials, or products, should be canvassed as a matter of routine. How can the D. & I.W.E. hope to have any success in this direction when they appear to have virtually no policy for a publicity or advertising programme? Surely this cannot be due to economy, when the British Transport Commission is spending tens of thousands a year to try and persuade the country to use yet still more the already over-loaded railway system? I say that they have practically no publicity policy, and base this statement on the fact that, to the best of my knowledge, they have not produced a single poster or leaflet advocating canal transport. When is press publicity solely for the canals to be embarked upon? Up till now there have been a few small and anæmic advertisements, casually mentioning the canals, which are not even included in the illustration, and in which the D. & I.W.E. takes an apparently subordinate position to the Railway Executive.

Further, why was the D. & I.W.E. not represented at the British Industries Fair in Birmingham, the city that is the canal hub of England, the centre of "The Cross"? What is going to be done to promote trade out of Birmingham in all directions by canal? At present, this trade is virtually non-existent. Again, what is going to be done to promote the flow of raw materials into Coventry by canal, a flow which, except for coal, is absolutely non-existent, so that canal warehouses have been let to road contractors? Finally, what is going to be done about the hundreds of factories up and down the country, whose water frontages are being used as rubbish tips, or just bricked up completely and the canal shut off?

With regard to the increased traffics mentioned by Mr. Ives, it would be instructive to know where these took place, and the percentage increases earned by private enterprise and the state owned carriers respectively. Mr. Ives apparently considers Canal-Rail-Road conferences for the scheduling of rates the panacea of all evils, but what is proposed to help the canals combat the evils of special rates granted by both road and rail carriers to secure traffic more suited for carriage by canal? Are covenants, with special rates, still in force to discourage the use of the ex-

Correspondence—continued

Railway canals? Are the "pirate" rates in use before nationalisation to be continued? How can Canal-Rail-Road conferences be of much value in the light of the foregoing? Is not the granter or recipient of a low rate going to keep discreetly quiet about it?

Mr. Ives gives scant consideration to the recruitment of new labour urgently needed to replenish the dwindling numbers of experienced canal boatmen, though he gives considerable attention to the details of staff recruitment for the executive and clerical branches! What is going to be done to help the boatman? What plans are envisaged to provide shower-baths or wash-houses at coal loading centres at the big inland ports? Are canteens and laundering depots to be provided at strategic points, and last but by no means least, what is to be done regarding educational and other facilities for the boat families? The Birmingham hostel, mentioned by Mr. Ives, may or may not be well advised, but in any case it shows no signs of materialising. Meanwhile, boatmen are leaving the boats because they are dissatisfied with the prevailing conditions, which give them the impression that there is no future in the industry. In short, what exactly is being done to attract desperately needed labour to the canal industry and to retain the essential existing labour?

In truth, Mr. Ives may well conclude his paper as I conclude this letter (the italics are mine) "on the part of traders and the general public, considerable interest is being displayed in the new organisation, *and there is a demand for the provision of better facilities which must be met.*"

Yours faithfully,
"WINDLASS."

London, S.W.19.
20th May, 1949.

Book Reviews

The Mersey Estuary, by J. E. Allison, 60 pp. with line drawings, photographs and Plans. Published by The University Press, of Liverpool, price 3s. 6d. nett.

The above publication, under the authorship of Mr. J. E. Allison, M.A., who is chairman of the Liverpool and District Branch of the Geographical Association, is of both technical and educational value. It is understood that the purpose of the author is to provide in a single and compact form a technical and historical record of the history of the Mersey and its influence upon the Great City of Liverpool, which is dependent for its existence upon safe access to the sea, by means of its river.

In the attempt at this purpose the Author has definitely succeeded. Although consisting of only 60 pages, this book is of a most comprehensive character and deals in considerable detail and yet concisely with such diverse and technical subjects as the History, Topography, Meteorology, Geology, Hydrography and Conservancy of the Mersey Estuary. Each of the above subjects forms the substance of a separate chapter and to do adequate justice to the book it is necessary to review these chapters in some detail.

Chapter I. This is the principal one and provides most of the substance relative to aspect and conditions of the Estuary. It introduces the "Western Sea Gate" and explains its geographical situation with economic reference to other countries and adjacent areas of population with a short resumé of its manifold war services. The physical aspect of the Estuary sea approaches are closely described with hydrographical details and diagrams relative to tidal action, shoaling and geological formation of the sea bed. It also deals with prevalent meteorological conditions as to wind forces, fog, etc., with reference to the effect exercised by the surrounding topographical features.

Chapter II is devoted to an historical account of the various means of "Crossing the Estuary," and traces the evolution of the several successive forms of ferries from earliest times.

Chapter III concerns the "turn-round" of vessels with a detailed record of dock developments and treats with the question of general construction and modernisation of docks, quays, and sheds and all the essential amenities for rapid handling of cargoes. It also includes mention of the lately instituted radar installation for the furtherance of safety and dispatch of shipping. In connection with this, a most interesting and explanatory photograph of the actual radar "display" is included.

Chapter IV presents an historical and comprehensive précis of the port approaches and traces the policy of the Port Authority in the development of a progressive system of revetments and training walls, etc., to overcome the many disabilities consequent upon physical and hydrographical conditions. It also gives a brief description of dredging in its several forms.

Chapter V deals with the subject of General Conservancy, and describes the constitution, organisation and functions of the existent Port Authority and defines its responsibilities. Details of these functions are given as relative to:
Pilotage; responsibility for ensuring safety to shipping; buoyage, lighting and salvage; hydrographical surveying—methods and practice; conservation of the Estuary with regard to the effects of constructional work therein.

Chapter VI. Conclusion with certain reflections.

Each chapter is well illustrated with plans, diagrams, etc., and includes many lesser subjects than recorded above, of considerable interest to the student of marine history. The title, indeed, appears somewhat inadequate with regard to the diversity of the contents of the book, as these far exceed in range the implication of the title.

This small volume, in fact, narrates not only the history of the Estuary, but also that of the entire port from when, in 1693(as noted and quoted) "Shippes lay aground before the towne of Liverpool, where t'is bad riding afloat by reason of the strong tydes, that ran there," until the final evolution of the large and prosperous port of to-day.

The entire publication can be defined as a veritable "multum-in-parvo" and should prove of great and instructive interest to those concerned with the Mersey Estuary and all pertaining thereto.

"Design and Construction of Reinforced Concrete Bridges." By A. W. Legat, M.Inst.C.E., G. Dunn, M.A., B.Sc., and W. A. Fairhurst, M.I.Struct.E.; 528 pages, 383 illustrations; 40 folders. Published by Concrete Publications, Ltd., London. Price 30s.

This volume makes available the results of the experience of three consulting engineers who have been responsible for the design and construction of a large number of reinforced concrete bridges of different sizes and types, and is notable for the completeness of the treatment of the subject and the useful information from the author's practical experience. It is probably the most comprehensive book on the subject published in any language. Subjects on which little information is now available, such as M. Pigeaud's complete curves for the design of slabs supported on four edges and cellular abutments, are dealt with at length. For the designer there are formulæ, charts, tables, and data for the rapid preparation of preliminary and complete calculations and estimates of cost for different types of bridges, recommendations for site investigations, structural and æsthetic design, drawing-office practice, and complete bills of quantities and specifications. The design of bridges that are statically-indeterminate structures is reduced to a very simple process without loss of theoretical accuracy. For the contractor there are fully-illustrated descriptions of all stages of the construction of bridges, including foundations, centering and shuttering, reinforcement bending and fixing, concrete making and placing, arrangement of plant, surface finishes, and other constructional details. For the student, this volume is a complete text book on the theory and practical design and modern methods of construction of reinforced concrete bridges of all types. A feature of the book are the examples of actual structures and reproductions to a large scale of many drawings, and the chapter on the strengthening and widening of bridges, with examples of work carried out by the authors, should be valuable to those responsible for this class of work.

Dutch Canal Widening.

It was recently reported from Amsterdam that work is to be started near Velsen on widening the North Sea Canal (Amsterdam-Ymuiden) from 124 to 200 metres over a length of 250 metres. The sand extracted is to be used in laying out a new main road from Amsterdam to Utrecht.

Radar in Restricted Waters

Some American Views on Operational Characteristics

By CAPT. W. R. GRISWOLD and ERIC J. ISBISTER.

At a meeting of the Institute of Navigation, held in London on February 18th last, brief details of which were given in the March and May issues of this Journal, one of the papers presented by two members of the American Institute of Navigation dealt with the above subject. The authors of the Paper reviewed the progress of radar as applied to open, coastal, restricted and river waters. A general survey was made of range selection, proper choice of anti-clutter position for rain and sea return, making landfall, and certain savings in time resulting from radar piloting. Problems arising from coastal, harbour and river piloting, general deterioration of the set, anomalous propagation, and use of radar beacons were briefly reviewed, as well as installation problems of marine radar. The need for proper training in radar operations was stressed, and a brief comparison of three versus ten centimeter equipments was made.

After discussing the functions of radar on ships at sea, and when approaching coastal waters, the authors said an important function of a marine radar is to furnish the Master of a vessel with sufficient information to enable him to bring his vessel into restricted waters to a point where he may either drop anchor awaiting docking instructions, or actually work his vessel to a spot where harbour tugs can place him alongside. This last function of the deep sea side of radar operation is perhaps the most controversial. Here the ship Master has so far been deserted by the shore agencies. If he brings his vessel in through the fog, he has in all probability violated company regulations and insurance provisions and left himself wide open to censure by governmental agencies. However, the task of bringing the vessel in is not as difficult as might be supposed. With modern commercial sets having a range resolution of forty to fifty yards, a minimum range of fifty or sixty yards, and range scales down to one mile, the task becomes quite simple. With such a presentation, channel markers—such as can and nun buoys—show up quite clearly, and for first-class markers, up to three miles. The cans are, however, easier to see than the nuns. Spar buoys are particularly hard to see much beyond half a mile. If these buoys could be equipped with radar reflectors, or if just the turning buoys could be so equipped, the job would be even easier.

This can be easily seen in Fig. 1, which is a picture taken from the bridge of a vessel off Old Point Comfort, Virginia. Notice the vessel slightly on the port bow and the buoy to his left. On the starboard bow and ahead we have vessels at anchor. The land areas are rather indistinct on the photograph. Fig. 2 is the radar picture of the scene shown in Fig. 1. The range is two miles and the presentation relative. The buoy and vessel to the port appear quite clearly, as well as the vessels at anchor. On the lower right is Old Point Comfort with Fort Wool between there and Port Elizabeth on the left side of the picture.

Fig. 3 is the chart picture of the western entrance to the Cape Cod Canal, showing Hog Island Channel and a sand spit to the left. The radar photograph (Fig. 4) of the same area is on the mile range with the true presentation. Note how clearly the buoys and beacons appear. The channel is 150 yards wide. The vessel at this instant is passing between buoys 5A and 6A, favouring the starboard side of the channel. Although she is a bit to the right of the centre line of the channel, it is still possible to see buoy 6A. This demonstrates very clearly that a set having a short enough minimum range provides all the information necessary to work into restricted waters. The radar used for this picture was a 3 cm. set having a one-quarter micro-second pulse with a pulse rate of one thousand.

This photo was taken in connection with a recent radar survey of the canal, conducted at the request of the U.S. Army engineers. The goal of the engineers is to compile a radar chart of the canal and eventually of all restricted waters under their jurisdiction, for the purpose of facilitating passage, in any weather, through those waters by vessels equipped with radar. They are already well advanced with a set of radar charts of the Mississippi River.

Probably the worst situation encountered in making for a channel under radar, is where a strong set across the channel exists. In these circumstances it is advisable to have the vessel lined up for the channel some distance away and get the feel of the current before entering the channel. However, an experienced skipper takes this in his stride. For instance, there is a spot in the St. Mary's River connecting Lake Superior with Lake Huron where a forty degree turn must be made to enter a channel only

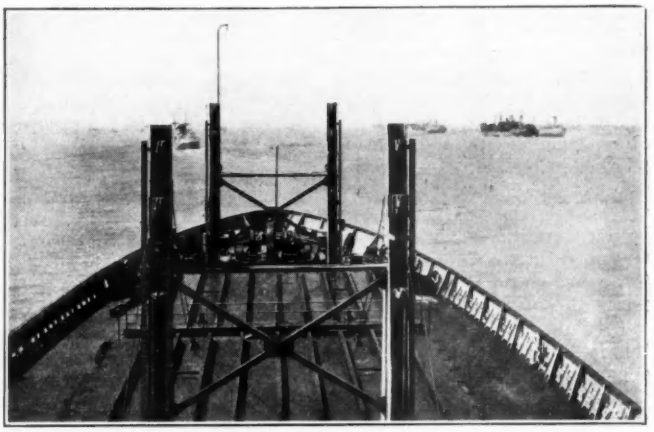


Fig. 1

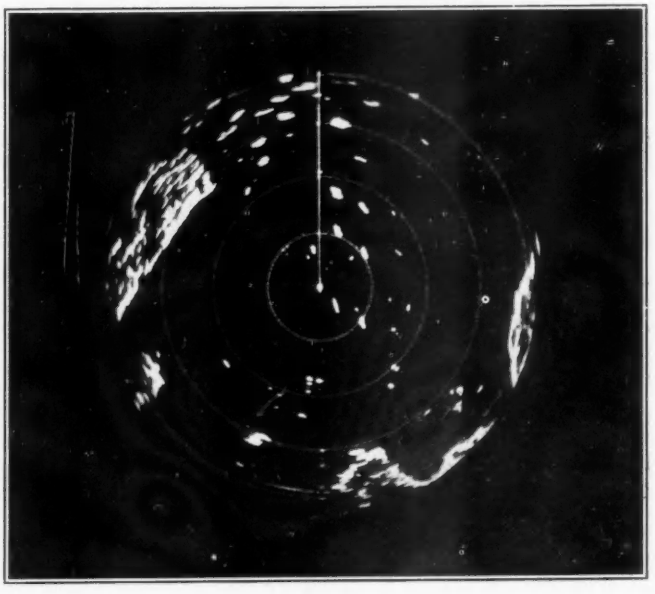


Fig. 2

three hundred feet wide. There is a three or four mile per hour current through the channel and only down stream traffic is permitted. This means that a vessel having once entered the channel cannot stop until it leaves the far end. Nevertheless, for several years now, lake vessels over six hundred feet long and displacing probably 14,000 tons, have been making this run in fair weather and foul. But then, they are sailing in fresh water, not salt.

Probably the most fascinating application of radar is the navigation in the Mississippi River and its tributaries such as the Ohio. Even here radar has to cope with two problems, as conditions are different on the Mississippi proper and on the tributaries. The Ohio, for instance, has a large number of dams and locks and, except in flood stage, is fairly quiet water, whereas the Mississippi runs free, and as it is in an alluvial plain, it meanders back and forth across the countryside, sometimes as much as two miles a month. The currents in the bends will often reach four miles an hour. (On the river, it is miles per hour, not knots.)

Radar in Restricted Waters—continued

A great deal of bulk cargo is carried by barges on this river system. A typical barge is 35 feet wide, 105 feet long, draws eight feet and carries a thousand tons. These barges are wired together in a rigid structure, usually three abreast, with the towboat fastened securely astern to push the tow, or in the vernacular of the trade, "shove the load."

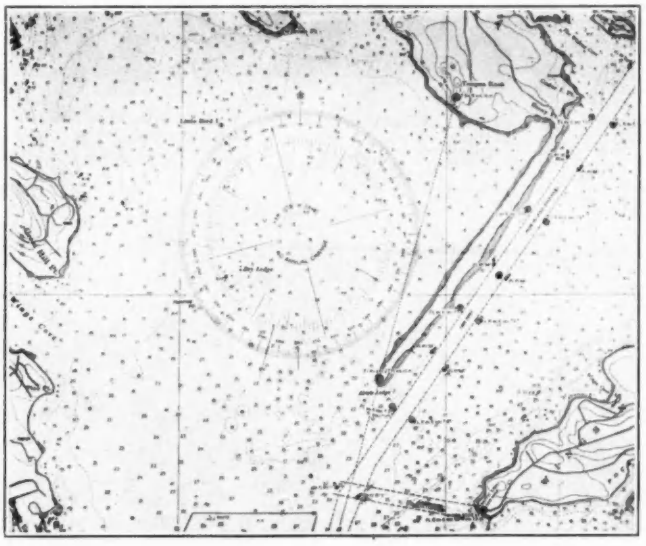


Fig. 3

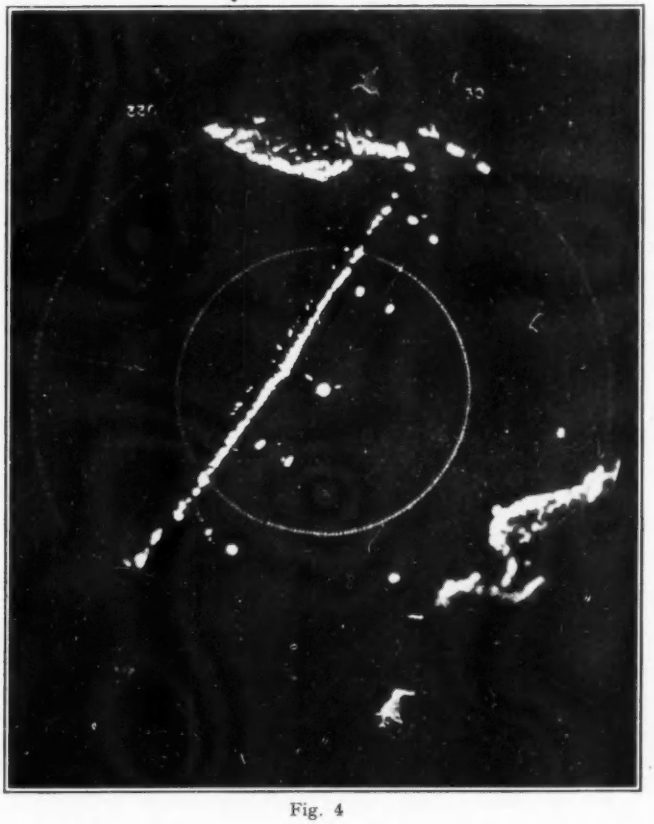


Fig. 4

On the Ohio it is common to have nine barges in a loaded tow and as many as fifteen empties have been successfully "shoved." Fig. 5 shows a typical modern tow belonging to the Ashland Oil and Refining Company. This tow consists of twelve barges. It is 925 feet long and carries 12,000 tons of oil, quite a respectable ship. With the powerful towboat shown, the combination will make four to five miles per hour. Some of the new boats will make twelve to fifteen miles per hour.

A typical lock on the Ohio is 110 feet wide and 600 feet long, necessitating splitting the tow at each lock. These locks are always located on the bank at one end of a dam. Fig. 6 shows a tow entering a typical lock. Fig. 7 shows the same scene on the radar scope. This picture was taken using a one mile sweep. The radar has a twelve-inch cathode ray tube and is otherwise as previously described. Notice particularly the appearance of the lock itself. Now most dams are not high structures like the one shown in the slide, but are low affairs, and during most of the year, water flows uniformly over them all across the river. When this is happening, the radar cannot see the dam when going down stream. Yet the pilots have such skill and knowledge of the river that they can easily recognise the small bump in the trace that represents the lock, and they regularly run these locks in fogs so thick they can only see half the tow.

Even though the pilots customarily use the F.T.C. to sharpen the picture as much as possible, it is none too clear at best, and this kind of operation is as much a tribute to the skill of the pilot as to the capabilities of the radar.

Because of the meandering properties of the Mississippi, the levees which restrain floods are spaced a number of miles apart and there is little electric power and few permanent land marks between them. The bends, islands, bars, etc., are therefore marked by large, white, wooden squares mounted on the bank, which are illuminated at night by ordinary kerosene barn lanterns. These, of course, do not show on the radar. The more difficult stretches of channel are marked by small buoys usually knocked flat by the current, so that they barely show going up stream and often not at all, going down, to either eye or radar. The problem is further complicated by the fact that an average round trip make take thirty days, so that the shape of the river may be different each time the pilot sees it. Steering is very difficult, due to the slow speed and general unwieldy characteristics of the tow. Nevertheless, radar equipped tows regularly navigate the river in all weather conditions. In the spring and fall, fog is a daily occurrence. Space does not permit a complete description of the difficulties of radar navigation on the Mississippi, but it is certain that a skilful pilot, using a good radar, can take any vessel in any condition of visibility just about anywhere he can take the vessel in clear weather.

The one problem which has stumped the river pilots and the radar engineers is a simple economical means for identifying bridge piers. A long tow must get into position to run a bridge as much as a mile away. The pilot needs positive identification of the two piers he must pass between. Unfortunately, bridges in general are such good reflectors that the piers cannot be distinguished at all. The first idea that occurs to one is to put a radar beacon on each bridge, but the first and particularly the maintenance costs make this impractical, as there are approximately 1,700 bridges over the Mississippi. The second suggestion is to place buoys in front of each pier. Unfortunately, they will not stay put. The perfect solution would be something on the tow independent of the bridge. Any ideas will be gratefully received.

In operations such as these, where absolute dependence is placed on the radar, its reliability becomes its most important characteristic. During the war, naval craft carried a highly trained technician to operate and maintain the gear. The merchant service could not afford such a luxury, so radar had to go out and stand on its own feet. The operators, though they have an uncanny skill in its use, can in general do only elementary repairs and service.

A recent survey made by the National Federation of American Shipping, Inc., is of interest in this connection. Thirty-seven companies reported on 141 installations on ocean-going vessels. All installations had seen at least six months' service, but the average was still only 10.3 months. Of these, 23 installations reported no failures. These, however, had only had an average of 8.6 months of service life. On the average, taking into consideration all installations, there was a failure every two months, for a total of 704 failures.

Radar in Restricted Waters—continued

Most failures, including gradual deterioration of performance, are due to vacuum tubes. As there are fifty to sixty tubes in average radars, and some of the special types have had only a short and hectic history, and are rated by their manufacturers at 500 hours of life, this is not surprising.

This being the case, the ship's officers can, if they are properly trained, do a great deal towards keeping the set in order. Some of the adjustments needed, particularly after changing the magnetron or a local oscillator, are reasonably difficult. Most

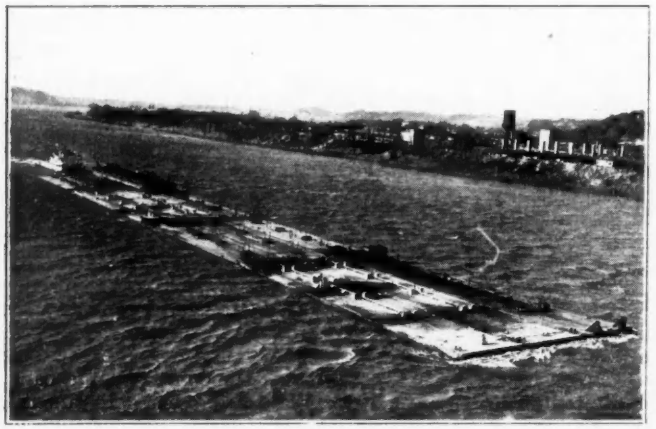


Fig. 5

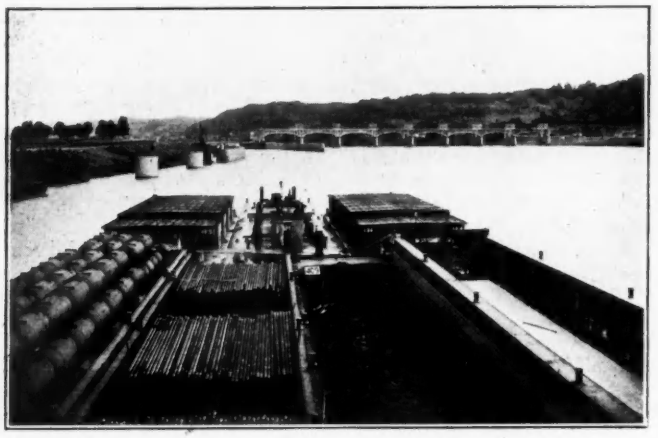


Fig. 6

U.S. manufacturers, however, provide adequate training in their schools, and the authors urge most strongly that the ship's officers be sent to these schools before being required to operate their vessels by radar. It may seem unbelievable, but all too many ships go to sea with a new radar and only such training as can be given in a few hours by the engineer supervising the installation. This is manifestly unfair to the officers concerned, and although most of them will rapidly acquire great skill in the operation of the equipment, they will be quite helpless when it comes to even simple repairs.

The U.S. Coast Guard is now requiring some knowledge of radar as one of the prerequisites for a deck officer's license. A very considerable amount of radar training is given in the U.S. Maritime and the State Academies, so that in time, ship's officers will be trained in the basic principles of radar operation and will have to attend the manufacturer's courses to obtain detailed knowledge about a particular equipment.

Even with considerable schooling, radar is an instrument where a great deal of practice is necessary and where a complete understanding of all operational aspects is required before any attempt should be made to work a vessel in restricted waters. A Master should never attempt to do with radar what he could not do with ease in clear water. A Master and the officers aboard should not wait for foggy weather before turning on a newly installed set. They should use it night and day until absolute trust can be placed in it and their own skill and judgment. In clear weather the vessel should be manœuvred by radar so that abilities can be developed and mistakes corrected. Then, when the first fog closes in, those on the bridge will have complete confidence in the radar.

Another factor which must be thoroughly understood and allowed for before making the first run in thick weather is the matter of blind spots in the radar picture caused by interference to the radio waves by the ship's superstructure. It is not always possible to instal the antenna on the highest point on board so that a 360 degree clear view is obtained. The next best location is one with no shadows from ahead to at least 135 degrees to

Fig. 7

starboard, as this is the sector in which other vessels have the right of way. However, at the present time, when most ships are not radar equipped, the Master of the radar vessel proceeding in a fog will do well to watch all around, as it is small comfort to be hit by another ship, even if it is the other fellow's fault. Therefore, the ship's officers must continually check for the presence of shadows under all conditions of weather, the size of the target, the state of the radar and the position of the ship's own gear, as the blackness of the shadows and their apparent width will vary considerably with all these factors.

In the United States there are still one or two operational characteristics of radar upon which opinion has not fully crystalized. One of these is the question as to whether three or ten centimeters is the better wave-length for marine operation. Experience seems to show that three centimeters is the more suitable. This is borne out by the fact that even though ten centimeter equipments were available considerably in advance of three centimeter equipments, more than half of the sets installed are three centimeter sets and now all manufacturers are offering three centimeter equipment while still using a reasonably sized antenna.

Another lesser controversy is over the choice between the so-called true and relative presentation. The former places north at the top of the picture and the heading flasher acts as a lubber line, giving the vessel's course when read off the azimuth range. This presentation is much like a chart, in that north is always at the top. Bearings measured on this presentation are true and

(*concluded on page* 61)

Hydraulic Models of Ports and Tidal Rivers

With Special Reference to the Bed Materials

By DONOVAN LEE, B.Sc. (Eng.), M.I.C.E., M.A.S.C.E.

While the recent discussions in this journal may have been easily followed it is possible that some basic information on tidal models may be helpful. The writer offers the following, realising that some of the views expressed may be open to controversy, with the wider objective of summarising briefly the fundamental requirements of such models and some of the difficulties and some points not touched upon in the recent contributions.

Models of this type are primarily used to ascertain the future behaviour of the prototype where silting or scour are causes of concern.

Often models are used to find the effect of new works and to arrange or adapt them so as not to cause silting of existing channels, and sometimes to find the best means of changing the flow or tidal currents so as to move away obstructive submerged banks and, for example, thereby save continuous dredging.

In all cases models enable comparatively inexpensive study of the effect of changes before they are made in the actual port or waterway, and due to the fact that the scale accelerates the time factor, the development of channels and banks can be forecast many years into the future in the course of a few weeks operation of a model.

It is clear, however, that for the foregoing to be achieved, a high degree of similitude is necessary between the model and the prototype. This is particularly so with regard to the bed material.*

While it would probably be true to say that very successful results have been obtained with models and their use is accordingly extending, it is also probably true that with regard to the bed material model similitude has only been obtained by coincidence if at all. The reason for this is that some of the requirements are mutually incompatible and there is no general agreement yet as to the relative importance of the various requirements.

The present practice with hydraulic models has recently been particularly well explained by Allen[1] and the fundamental equations are given in a recent publication by the American Society of Civil Engineers[2]. Nevertheless brief references to the fundamental relations and to current practice may be desirable.

Hydraulic models may be broadly divided into two types—those in which the horizontal and vertical scales are equal, and those in which there is distortion of vertical scale with regard to horizontal scale; distortion is invariably an increase of depth in proportion to length.

The former have to be used for models in which wave action is of importance, since distortion cannot be produced in the waves in the model, but this type have also been used, for example by Laurent in France, for models where wave action is not of importance. In nearly all other types of models some degree of distortion is usually found desirable in order to maintain practical minimum depths of water in the model and to enable the corresponding acceleration in the time factor to be obtained.

In open channel models, such as those of rivers or estuaries, since the main activating force is gravity, the models are designed in accordance with Froude's Law. The time ratio then becomes for undistorted models $T = L^{\frac{1}{2}}$, where L = ratio of lengths, and the velocity ratio becomes $V = L^{\frac{1}{2}}$, assuming g constant and the use of similar fluids in model and prototype, say salt or fresh water.

However, using a distorted scale these two relationships are modified as follows:—

$T = \frac{x}{y^{\frac{1}{2}}}$ where x = ratio of horizontal lengths

y = ,, ,, vertical distances.

$V^1 = y^{\frac{1}{2}}$ where V^1 = ratio of horizontal velocities which can be rewritten as

$T = x^{\frac{1}{2}}D^{\frac{1}{2}}$ and $V^1 = \frac{x^{\frac{1}{2}}}{D^{\frac{1}{2}}}$ where $D = \frac{x}{y}$ = model scale distortion.

Thus a reduction of horizontal scale produces at once a reduction of both time and velocity, and their scales. The time scale is further reduced by an exaggeration of the vertical scale, but the velocity scale while still less than nature is greater than in an undistorted model.

Many hydraulic models constructed to date have been of rivers and estuaries, where horizontal distances are very large compared with depths. If this type of model is constructed to an undistorted scale, depths and velocities are so small that the flow is laminar and the flow of water would be insufficient to move on the model bed any ordinary bed material.

In nature the flow of rivers and around tidal ports is invariably turbulent and the Reynolds number for the model may need to approach or exceed 2000; an American rule is that in foot second units the product of depth and velocity should exceed 0.02.

The reduction of the time scale following distortion has another advantage, for it means that the behaviour of the prototype over a period of years can be examined by running the model for a still shorter time than would be necessary with no distortion.

It can therefore be said that for most models of the port and tidal estuary type, some degree of scale distortion is desirable in order to:—

1. Produce turbulent flow in the model.
2. Reduce the model running time.
3. Produce velocities in the model sufficient to move a practicable bed material.
4. Make depth variations measurable.

Apart from the desirable features of distorted models, experience has shown that they can be used with success. Although the degree of the distortion used has varied largely, great distortion introduces complications which are material though the limits are only roughly established.

The following table shows the distortion used in some recent cases:—

Model	Type	Horizontal Scale	Vertical Scale	Distortion
Zeebrugge[3] ...	Port	1 : 400	1 : 60	6·67 to 1
Abidjan[3] (Ivory Coast) ...	,,	1 : 270	1 : 120	2·25 to 1
Hook of Holland[3]	,,	1 : 1,000	1 : 150	6·67 to 1
Wilhelminahaven[3]	,,	1 : 200	1 : 75	2·67 to 1
Severn[1] (*a*) ...	Estuary and river	1 : 8,500	1 : 100	85 to 1
,, (*b*) ...	,,	1 : 8,500	1 : 200	42·5 to 1
Rangoon[1] ...	,,	1 : 8,060	1 : 192	42 to 1
River Parrett[1] ...	,,	1 : 3,000	1 : 260	11·5 to 1
Cheshire Dee[1] (*a*)	,,	1 : 5,000	1 : 200	25 to 1
,, (*b*)	,,	1 : 40,000	1 : 400	100 to 1
Great Ouse & Wash[1] ...	,,	1 : 2,500	1 : 60	41·7 to 1
Humber[1] ...	,,	1 : 7,040	1 : 192	36·6 to 1
Mersey[1] ...	,,	1 : 7,040	1 : 190	37 to 1
Seine[1] ...	,,	1 : 40,000	1 : 400	100 to 1
Penang, Malaya[5] (*a*)	Port	1 : 1,500	1 : 75	20 to 1
Prai Estuary,[5] Malaya (*b*)	Estuary	1 : 600	1 : 150	4 to 1
Mississippi[4] ...	River	1 : 2,000	1 : 100	20 to 1

Since in the majority of hydraulic models of ports and rivers the necessity for the study is to find the cause of silting or scouring that has occurred and the probable effects of artificial changes in the waterway before they are carried out, the bed material is of the first importance; in fact unless it is clear from the beginning that true similitude with the bed material is a possibility there is a risk that the whole model will be valueless.

*The exception is where silting and/or scour are not involved as in models solely concerned with the shelter from waves provided by breakwaters and harbour entrances.

Hydraulic Models of Ports and Tidal Rivers—continued

The ideal characteristics of the bed material for models are :

1. The bed material should be moved by the scalar flow and deposited as in the prototype.
2. Material in suspension at the point of entry should settle out in the same area as in Nature.
3. The underwater slopes should be of practically the same stability, although probably of very different slope from that in Nature.
4. Any effect of waves on shallow banks should be reproduced.
5. The preceding conditions should take account of any change in viscosity, due to using fresh water in the model instead of salt water and to temperature differences.
6. The bed material should not be subject to physical or chemical change during the time of use of the model.

Possibly there are others, but these are the more important.

Is it possible that any material could reproduce all these features, particularly when, as is usual, a distorted scale is used ?

The answer must be that it is not possible to obtain complete model similarity but where the relative importance of one of the above requirements is great, very satisfactory model similitude can be achieved.

It is the fundamental requirement of all models with mobile beds that the bed material will be moved as it is moved in Nature.

By the formula developed from experiments carried out by Chou in the Victoria University of Manchester,[7] and at the U.S. Waterways Experiment Station, Vicksburg,[8] Mississippi the mean velocity of flow of a channel, v, in ft. per sec. is given by :—

$$v = K \left(\frac{L + B}{2l}\right)^{0.44} (\sigma' - \sigma)^{0.22} l^{0.22} M^{-0.22} h^{0.06} m^{0.22}$$

where K = 1·10 for movement of first few particles
K = 1·59 for movement of many particles
σ' = specific gravity of bed material
σ = specific gravity of water
h = depth below water surface of portion of bed under consideration in inches
m = mean hydraulic depth of section considered in inches
L = mean length of grains as viewed under a microscope in inches
B = mean breadth of grains as viewed under a microscope in inches
l = length of side of a cube having the same weight as the average grain (inches)
M = uniformity modulus of bed material.

The bed materials used in the experiments ranged in size from equivalent cube lengths l from 0·00384 inches to 1·03 inches, and specific gravities from 2·016 to 3·89, and the channels used were straight and parallel-sided.

In a model, however, irregularity of contour and cross-section produce conditions of turbulence and pronounced eddy-formation. Thus, although the mean velocity of flow at any given section of the model may be the same as that in an equivalent channel obeying the formula (1), the maximum velocity on parts of the bed of the model may be considerably greater than that in the equivalent channel.

On the assumption only that the velocity on the bed of the model is the main factor causing bed disturbance, it therefore follows that the given bed material will be more mobile in the model than in the apparently equivalent flume section. The formula does undoubtedly take account of shape of cross-section with the terms h and m, but on the assumption that the particular channel under consideration is parallel-sided. No account is taken, however, of irregularity of cross-section and, in particular, the longitudinal bed slopes.

The only factor remaining in the formula which can take account of the reduction of disturbance velocity (other than purely physical constants of the materials used) is the factor K.

During the Vicksburg laboratory tests, it was shown that the rippling of the bed reduced disturbance velocities compared with a smooth bed by more that 30 per cent. It seems more than likely, therefore, that the irregularity of shape of an hydraulic model has at least a similar effect on the disturbance velocity, and on K.

As, in this formula, the particle size for constant disturbance velocity is proportional to $K^{4.55}$, an accurate K value becomes essential to allow correct determination of the model grain size.

It can be shown that for constant K value, uniformity modulus M, shape factor $\frac{L + B}{2l}$, effective density $\sigma' - \sigma$, and channels in which m = h, for model similitude $R = \frac{1}{y} = \frac{D}{x}$

where R = ratio of mean particle size, model to natural

D = Distortion of scale, $= \frac{x}{y}$

$y = \frac{\text{natural depth}}{\text{model depth}}$

When compared with the requirements for similarity of settlement velocities, this shows that at one and the same time the two conditions cannot be realised by one size of a given bed material.

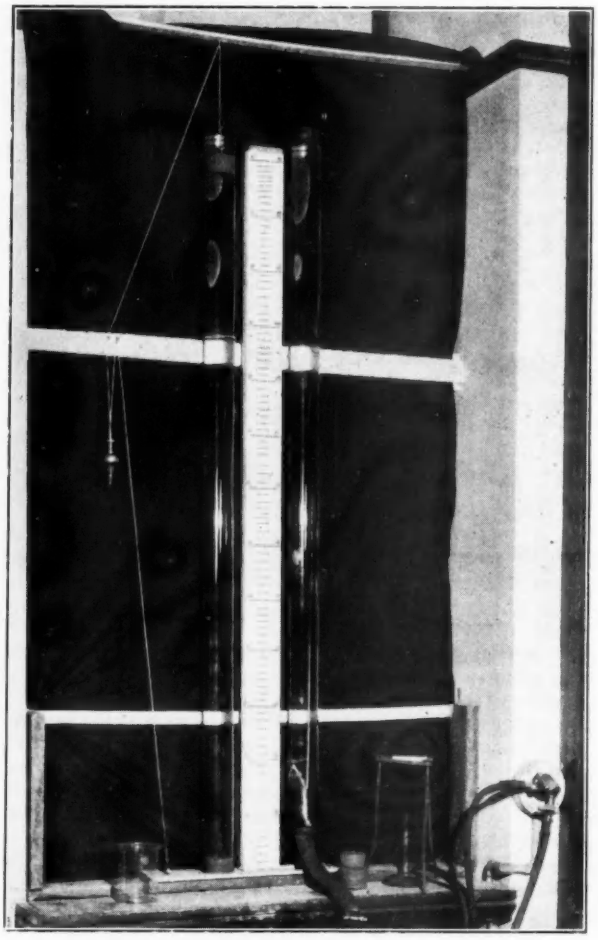


Fig 1.

Generally it means that if the suspended material settles on the bed with the correct scalar velocities, it would have to be of such a size that the scalar horizontal velocities would be inadequate to move the material along the bed according to Chou's formula. Similarly if the material were of the correct size to be moved off the bed by the scalar flow, it would be so small as to be far too mobile in suspension.

A practical solution to the difficulty of producing a sufficiently rapid settlement velocity, in models where most of the material transported was in suspension, has been to use alum as a coagulant, thereby increasing the settlement speeds, and at the same time to use a granular bed material which is disturbed as in nature by the scalar velocity of flow.

Hydraulic Models of Ports and Tidal Rivers—continued

The two difficulties which stand out when attempting to make practical use of Chou's formula are :—

(*a*) There is no well-established relationship between the performance of bed material in a distorted model and in flume tests such as those on which the formula is based.

(*b*) In many models, to obtain a faithful reproduction of bed movements in the prototype a much lower specific gravity is necessary for the bed material.

Too much dependence seems to have been placed in the past on fine sand for the beds of models and too little also to expecting materials of low voids ratio to have any approach to model similitude.

As a result of both study of the formula and the results obtained, comparing this with the behaviour of bed materials in hydraulic models, the writer came to the conclusion that the formula is of little use in some cases though it is not impossible that some experience exists which would make the formula adaptable for use in hydraulic models other than those of low or zero degree of distortion.

Settling out of Material in Suspension

Material in suspension may in Nature enter the area being studied and settle out within the area, as for example, in the case of rivers entering sea water. In addition, material already in the bed may be disturbed and put into suspension.

In both cases the ideal model should reproduce a settling out of suspension at the same area in the model as occurs in Nature.

The lengths and times involved are dependent on the scales employed.

For geometric similarity, the horizontal distance that a particle travels in a model is $\frac{1}{x}$ times Nature, and this has to take place in time $\frac{1}{x^{\frac{1}{2}}}$ times Nature (for undistorted models) ; hence the particles must settle out of suspension at a rate equal to

$$\frac{1}{x} \div \frac{1}{x^{\frac{1}{2}}} = \frac{1}{x^{\frac{1}{2}}} \text{ times Nature.}$$

For distorted models, the distance to be travelled is $\frac{1}{y}$ times Nature, and the time available is $\frac{y^{\frac{1}{2}}}{x}$ times Nature. The vertical settlement velocity in the model must therefore be $\frac{1}{y} \div \frac{y^{\frac{1}{2}}}{x} = \frac{x}{y^{1\cdot5}}$ = N times the velocity of settlement in the prototype. If, for example, x = 1000 and y = 50, $N = \frac{1000}{354} = 2\cdot83$; but if x = y = 1,000 then N = ·032.

Stokes' law for the settlement velocities of small particles is as follows :

$$V = \frac{2}{9} \frac{(\sigma' - \sigma)}{\eta} \cdot gr^2$$

where V = settlement velocity of particle
σ' = density of particle
σ = density of liquid
η = viscosity of liquid
r = equivalent particle radius.

Apart from the effects of varying temperature and viscosity, it would appear from Stokes' law that scalar settlement velocities could be achieved by (*a*) using a bed material of the same size and shape as the natural bed but having an effective density in water N times as great, or (*b*) using the same material as in nature but $N^{\frac{1}{2}}$ times the diameter. (*a*) is impracticable because no readily available material exists, except for values of N between 1·0 and say 0·5, which very rarely arise ; (*b*) is impracticable because for small sizes it is very difficult to produce the requisite size accurately and for large and very fine sizes it can be shown Stokes' law does not in fact apply.

Particles below about 0·0002 mm. diam. remain in colloidal suspension, and some experiments carried out by C. E. Riches in conjunction with the writer enabled the upper limit of validity of Stokes' law to be defined at approximately 0·15 mm. in the case of sand.

The apparatus (fig. 1) consisted of long glass tubes into which small quantities of sand were successively admitted at the top and allowed to settle to the bottom, the distance and time being recorded. The settlement velocities were afterwards calculated and are shewn on fig. 2, which also shews for comparison the theoretical curve according to Stokes' law. The sand particles were all angular and irregular ; similar tests carried out on roughly cubical particles of granulated Perspex after correcting for specific gravity (1·18) by multiplying the observed velocities by $\frac{2\cdot65 - 1}{1\cdot18 - 1} = 9\cdot16$, gave points widely different from the sand curves shewn, the "corrected" velocities being about 2½ times the velocities of sand grains of the same size.

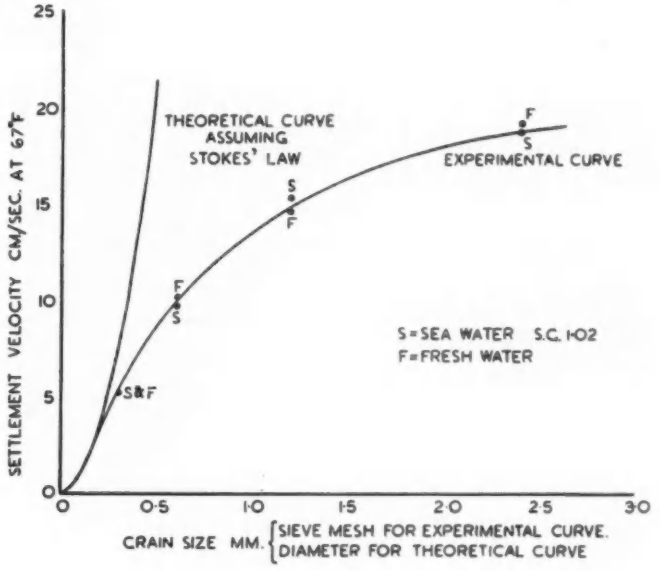


Fig. 2.

The curve of fig. 2 is not necessarily typical of all sands ; sand grains of more ovoid shape settle more rapidly.

The tests were repeated several times for each grading until the shortest time had been recorded at least four times out of nine tests, and the curve in fig. 2 is based on the corresponding maximum velocity in each case.

It has been suggested[1] that sea water has a very considerable effect in increasing settlement velocities, figures up to eight times having been mentioned, and while there is such an effect in the case of extremely fine material it is also clear from fig. 2 that there is no appreciable effect, if any at all, on the settlement of coarse grains.

Although Stoke's law is in any case only applicable to settlement in still water, the effect of the current in delaying settlement applies to both model and prototype, even if not proportionately.

The inevitable complications that arise from having an additional material added in suspension in the model to represent similar material entering the corresponding section in nature, coupled with the few cases in nature where the material in suspension is a measurable fraction of the material moving along the bed, has resulted in this being invariably ignored. It cannot, however, be overlooked that in some deltas flocculated fine material can be the principal cause of silting.

Under-Water Slopes

The angle of repose of granular materials under water is the same as in air, so long as there is no movement of the water, but with hydraulic models there is practically always sufficient movement to materially reduce the slope, except where the bed material is cohesive under water.

Hydraulic Models of Ports and Tidal Rivers—continued

Even in models in which only a low degree of distortion is used, it would seem impossible to obtain the accentuated slopes which true dimensional similitude would call for.

Curiously, however, experience does not confirm this, as quite steep banks can be formed in a distorted model; presumably cohesion is sufficient in these cases to hold up the very small steep slopes. Where steep slopes are called for by the distortion of the model, the shape of the bed in that part can be formed of rigid material such as cement and sand mortar. The objection is that it is only correct to do this if the previous history of a prototype shows clearly that the bed in that part of the prototype is of material that cannot be eroded.

The Effect of Waves on Shallow Banks

The local effect of wave action on a shallow bank is to cause increased turbulence, which may produce sufficient impact and local velocity to disturb the bank material, although the general average velocity of flow may be insufficient to do so. Having been once disturbed, the material would be carried along by the stream until the local velocity is insufficient to move the material further. The relation between distortion and the bed material in this case is not known by the writer.

However, as in distorted models scalar waves cannot be produced, the effect on erodable beaches can only be simulated by causing local disturbance at the water's edge say by the use of jets of air.

Effect of Change in Viscosity, Temperature, Etc.

The viscosity of both salt and fresh water decreases by approximately 40 per cent. when the temperature rises from 40°F to 80°F, and therefore a close control of temperature is necessary.

There is also, of course, a change in viscosity where salt water and fresh water meet in the prototype. In the vicinity of a river entering the sea there is stratification of the water.

While in nature the salt water will tend to flow into a river and fresh water be running out over it, due to the difference of specific gravity, in the model this can only be roughly reproduced by the "fresh water" being kept at a higher temperature than the "salt water."

It will be seen that the effect on the bed is otherwise for the flow to be normally in a direction the reverse of that in the prototype.

Conclusion

While the general practice previously has been to use several bed materials successively and to find by comparison which reproduces most faithfully the previous known history of the silting or whatever bed movement is particularly desired, the recorded experience of this method does not seem to indicate that it is really very satisfactory.

It seems firstly that the bed material should be selected by some careful analysis of the properties it should possess, taking account particularly of the scale ratios and the effects of distortion in accentuating turbulence in the direction of flow.

The movement of any material which, by reason of littoral drift or gradual movement along the bed of a river, enters the area covered by the model, should correctly be "fed" into the model.

Any material which is brought in suspension into the area covered by the model, should be represented by a material different from the bed material referred to previously as both its rate of settlement is of importance and the subsequent movement on the bed should be, ideally, the same as the main bed material. Unfortunately almost any material which will settle out to scale will not subsequently behave to scale as a bed material.

It is apparent that the considerable number of complex factors influencing the behaviour of bed materials will not allow, by direct calculation, the precise determination of the material to be used in a particular model, but it does allow of eliminating many materials and ranges of particle sizes which have no possibility of meeting the requirements of model similitude.

The writer is indebted to Mr. J. A. S. Rolfe, M.I.C.E., M.I.Mech.E., Dr. Jean Laurent and Dr. Jack Allen, M.I.C.E., for discussion on this subject and for the benefit of their views.

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Canadian Ports

Excerpts from the Annual Report of the National Harbours Board of Canada for the Year 1948

The thirteenth annual report of the National Harbours Board of Canada, covering the operations for the calendar year 1948, of the harbours of Halifax, Saint John, Chicoutimi,, Quebec, Three Rivers, Montreal, Churchill and Vancouver and the Government grain elevators at Prescott and Port Colborne, states that vessel arrivals numbered 43,627, the aggregate net registered tonnage being 33,006,672. The comparable figures for 1947 were 42,876 vessels aggregating 29,856,603 net registered tons.

Cargo Tonnage

The aggregate cargo tonnage in 1948 at all harbours administered by the Board was 31,783,586, as compared with 31,163,807 in 1947. The increase over the previous year was 619,779 tons, or about 2 per cent. Domestic traffic increased by 13 per cent. but foreign declined by 4 per cent. Inward foreign traffic increased by over one million tons but the outward movement to foreign countries was below that of 1947 by over 1,800,000 tons.

Revenues and Expenditures

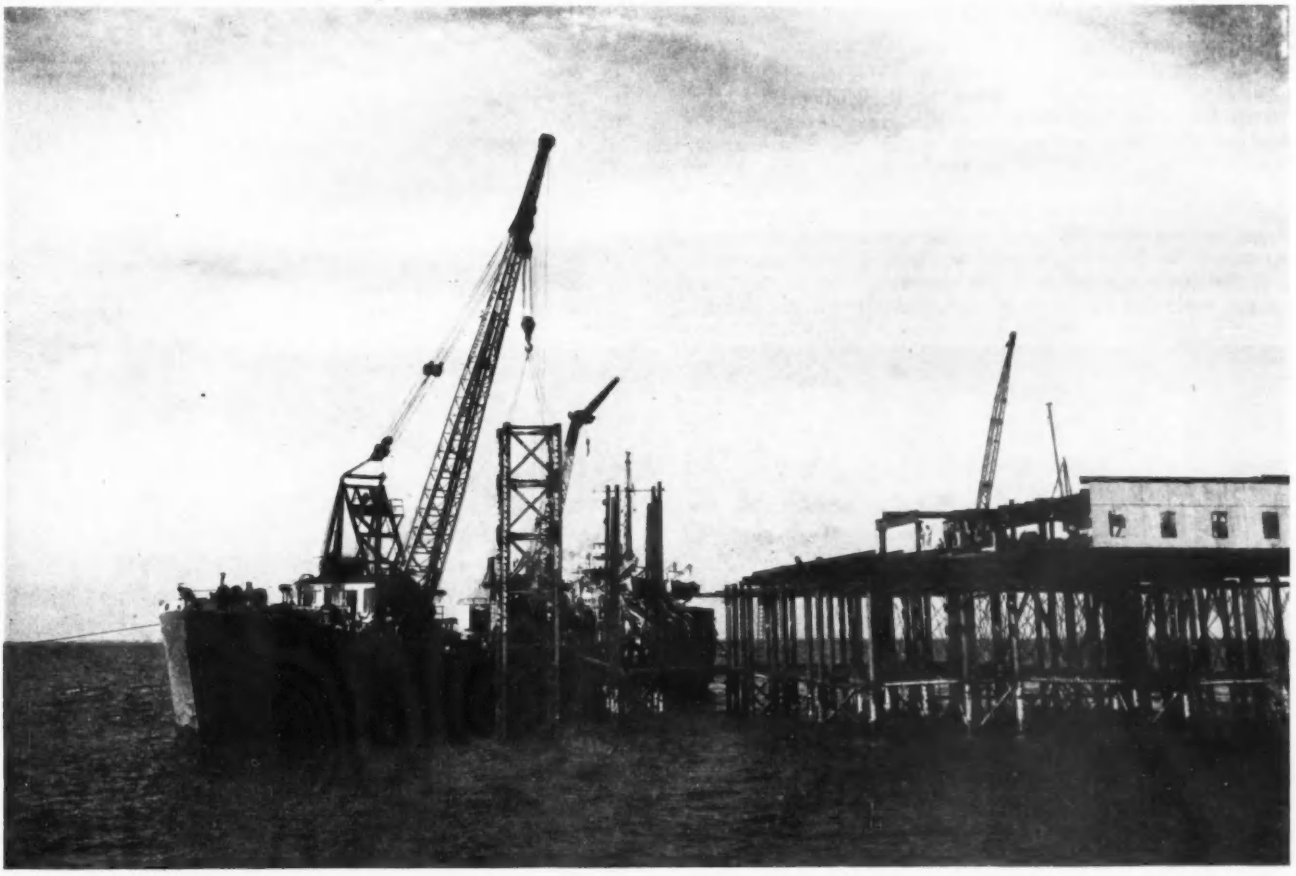
Operating revenues of all units administered by the Board amounted to $12,830,784, as compared with $11,830,910 in 1947. The increase was $999,874, or 8 per cent. Earnings derived from the use of wharves and sheds were slightly lower than in the previous year, but increased revenues were obtained from grain elevators, terminal railways, cold storage warehouses, toll bridges and miscellaneous services.

Expenses of administration, operation and maintenance in 1948 were $7,608,578, as against $7,010,775 in 1947, an increase of $597,803 or 9 per cent. Of this increase, $252,178 arose from additional outlay on maintenance of properties, upon which the total expenditure was $2,090,886.

Operating income in 1948 showed a gain of $402,071, the comparable figures being $5,222,206 in 1948, and $4,820,135 in 1947.

After taking into account debits and credits to income and charging interest and reserve for replacements,, the operations for 1948 resulted in a net income deficit of $2,042,353. This compares with a deficit of $2,410.062 in 1947. The deficit decreased, therefore, by $367,709.

While some special service tariffs have been adjusted from time to time because of rising costs, harbour dues, dockage and top wharfage charges remain on the same basis as prior to the war. In 1948, total revenues of the Board were nearly $3,700,000 in excess of those of 1938. Operating expenses have risen $3,200,000, or 73 per cent. in the interval. Since the Board's chief sources of revenue are from charges that have remained unchanged, it is apparent that the increased costs of operation and maintenance have been met largely as a result of the high level of business activity.



Several phases of construction proceed simultaneously on different parts of the Platform as rapidly as erection of the foundation permits.

Off-Shore Boring for Oil

Drilling Platform in Gulf of Mexico

The search for oil in Southern Louisiana has always been beset with more than ordinary difficulties; indeed, the boggy marshes and swamplands of that area have provided the oil industry with some of its greatest problems. Still greater problems challenge any further development of the state's oil resources. To supply the demand for more crude oil, the search for new oil reserves has been extended beyond the Bayous to the blue waters of the Gulf of Mexico overlying the continental shelf, and attention is now centred upon this newest oil area.

On Grand Isle, a long, narrow strip of oak-studded sand some 45 miles south of New Orleans, there recently was a bustle of activity as Humble Oil & Refining Company's drilling platform eight miles off-shore approached completion. Trucks rolled up to the newly completed warehouse, and boats moved busily to and from the new structure in the Gulf. From the beach it seems as though a great ship, attended by a fleet of tugs and barges, has anchored on the horizon. The drilling platform towers above everything in sight, and the derrick floor, 60 feet above the Gulf, looks down on the two decks which measure 206 by 110 feet. The lower deck is 32 feet above mean Gulf level, well out of reach of the highest waves.

It requires a large and strong structure to support a drilling rig with its crew and supplies, and also to withstand the onslaught of potential 120-mile per hour gales driving waves 35 feet high in the open Gulf, unprotected by shoals or reefs, in water almost twice as deep as at any site where drilling has hitherto been carried out.

Comfortable Living Accommodation

It is possible to drill seven wells from this structure, whose two half-acre decks hold a complete rig and comfortable living quarters for 54 men. Arrayed on the top deck are quarters, racks for 15,000 feet of drill pipe and long strings of casing, and the specially reinforced derrick. This lattice of steel was designed to withstand hurricanes unassisted by guy wires, and has nearly twice the strength of its land counterpart. The mud storage room, living quarters, and well area on the lower deck are sheltered from off-shore winds by thirteen fuel and water tanks on the seaward end of the structure.

Never before has anyone attempted to construct a stationary drilling island in fifty feet of water in the hurrican-swept Gulf of Mexico, where occur some of Nature's worst storms. There it must stand, anchored by its 100 piles, many of which sustain loads of 250,000 pounds each, driven deep into the soft, silty clay below. Skin friction alone, between steel " H " beam piling and the soft alluvial soil, supports the 10,000,000 pound structure.

Problem of Wave Forces

It was anticipated that there would be extended periods when rough seas would prevail, making marine transportation operations irregular. To cope with the weather, it was decided to provide for enough drilling supplies, food, and other provisions to permit unsupplied drilling operations on the structure for as long as two weeks at a time, regardless of the squalls and storms of the Gulf.

From the first, the sea loomed as the greatest problem in constructing this drilling island. The forces of the Gulf in deep water were unknown. The Scripps Institute of Oceanography, U.S. Army Engineers, and others were consulted in gathering data on wave forces, wave height, and the frequency with which waves would strike the structure. The same oceanographer who assisted in forecasting sea conditions for the Normandy invasion in 1944

Off-Shore Boring for Oil—continued

was employed to study wave forecasting in the Gulf of Mexico. The results of these studies, together with the records of the U.S. Weather Bureau, revealed the power of the elements.

From this data, engineers calculated the forces expected to affect the structure, and tests were made on the bearing of the soil beneath the Gulf. Six core test holes, one from the top of a 24-in. pipe test pile driven into the Gulf, were drilled in the vicinity of Grand Isle, providing information and samples of soil formations down to about 400 feet. The soft soil required unusually deep penetrations for piling, and the piles were driven from 147 to 197 feet into the Gulf floor, yet far enough above the first firm bearing stratum to permit uniform settling of the entire structure.

with the arrival of steel in the spring of 1947. Prefabrication of the 10-inch " H " piling and the tubular steel templets proceeded rapidly at the yard in New Orleans. Here the portions of the templets which would be subjected to the slapping of the waves were sheathed in corrosion-resistant layers of Fiberglas and tar. The remainder of the steel in the structure was coated with Humble Rust-Ban and enamel finished.

Rapid Construction

The steel piling in lengths of 53 and 120 feet was loaded aboard the barge, " Cap," a converted L.S.T. fitted with two cranes and a battery of welding machines. In the care of a tug and a con-

Lead Section of pile is guided into 16-in. dia. pipe leg of prefabricated templet as construction of foundation for the Platform proceeds.

Each of the one hundred piles in the structure consists of a lower section 120 feet long, three 53 foot sections being added as the pile was driven down.

Designing the structure required extensive investigation, as nothing quite comparable had ever been built before to resist such forces under such conditions. After months of study, the most practical design proved to be a network of welded steel "templets" and braces mounted on piling. " Templets " are the 18-ton prefabricated sections of pipe 72 feet long, sunk 15 feet into the Gulf bottom, which serve as supports and guides for the piling. Turnbuckle rods and 8-inch pipe spacers between the templets brace the structure internally, topped by 24-inch and 30-inch " I " beams supporting the treated timber decks. No guy wires or external braces of any kind help the structure resist the pounding of the Gulf, thus permitting boats to approach from any direction.

Construction of the drilling island, now in its final phase, began

verted L.C.I., the "Cap " and two L.S.M. barges loaded with the templets sailed down the Mississippi for Grand Isle in mid-November, 1947. After some delay, due to rough weather, the first pile was driven on November 30. Construction progressed rapidly, speeded by refinements developed on the job. One of the most important of these was in anchoring and manœuvring the " Cap " by means of the five anchor lines, each of which was attached to two 11,000 pound anchors. Despite the loss of more than 15 days, due to rough weather, the structure was completed on schedule early in March.

Powerful Drilling Rig

Erection of the Humble Company's most powerful drilling rig began even before the final completion of the structure. Two light-weight Diesel " quad " units, actually eight engines in all, will supply 1,200 horsepower to the new, extra-heavy draw-works.

Off-Shore Boring for Oil—continued

Three more Diesel "quad" units, chosen for their compactness and light weight per horsepower, will provide 1,500 horsepower to the three big mud pumps.

Skid-mounted units, permanently mounted on the upper deck, will permit cementing, well logging and gun perforating as needed, thus eliminating delays and marine transportation problems which would accompany employment of mobile service units.

Located in the centre section of the lower deck, shielded from the elements by steel wall panels, are the pumps and tanks of the drilling mud system. There three 200-barrel mud tanks, laced to the pumps with 12-inch and 16-inch lines, stand beside thousands of sacks of mud materials. 1,620,000 pounds of drilling-mud materials and cement may be stored here, enough to combat the most extreme sub-surface pressures should they be encountered.

On the north-east corner, sheltered from the noise of drilling by the mud storage area, are the quarters for the drilling crews. A dining room, kitchen, recreation room and bedrooms for 34 men

Drilling operations ready to commence from the completed Platform in 48-ft. of water.

are provided on the lower deck, and directly above on the upper deck are seven more bedrooms and an office. The quarters are steam heated for winter, well ventilated in summer, with water and sewer systems to provide complete facilities for the comfort of the personnel.

Safety Precautions

Although protection from the sea and the weather were paramount considerations, fire has not been overlooked. Fire nozzles are at strategic locations over the entire structure, supplied by a Diesel and an electric pump. Chemical and foam-type fire extinguishers are on hand also, and every precaution is taken to safeguard the use of Diesel fuel, the only combustible liquid on the structure.

Historic Grand Isle, many of whose inhabitants are descended from Jean Lafitte's buccaneers, was selected early as a base for Humble's off-shore operations, which range 75 miles from the mouth of the Mississippi River to the Atchafalaya Bay. With Barataria Pass and Bayou Rigaud providing the only harbour which affords shelter from the open Gulf, centrally located Grand Isle is the only place in the area where the coast is accessible by road. Warehouse and office space and docking facilities have been constructed on Grand Isle to support the off-shore operations. Two harbours and a mile of channel have been dredged in Bayou Rigaud, and more than a mile has been dredged seaward from Barataria Pass to permit deepdraft seagoing tugs and barges to enter the harbour.

Maintaining Supplies an Important Consideration

Due to the lack of fresh water below ground, water for drinking and maintenance purposes, both on the structure and on Grand Isle, is one of the most pressing problems. It must be barged from New Orleans via the Mississippi River, a 24-hour trip. Food and drilling supplies also must be barged in or trucked along the 120 miles of road from New Orleans.

The spectre of bad weather and rough seas is never far removed, and co-ordination of supplies and transportation is an important matter. An oceanographer, employed by Humble, will provide continuous wave and weather information to the fleet of crew boats, tugs and barges based at Grand Isle. Assisted by data from the U.S. Weather Bureau, accurate forecasting of wave height and weather conditions will greatly enhance safe and efficient operations. The entire fleet is equipped with Very-High-Frequency (V.H.F.) radio equipment, and radar sets are being installed in some vessels for safer navigation.

Perhaps the greatest difficulty in marine operations is in safely transferring men and supplies on and off the platform, and much time has been devoted to the problem. A significant development in this respect is the personnel landing ramp designed by the Petroleum Engineering division. There are four of these walkways, allowing boats to approach the protected side of the structure regardless of the direction of the wind and waves. The ramps, equipped with handrails, are mounted at each end to permit them to sway with the roll and pitch of the boats. The ease of transfer has proved the success of the design.

Future Operations Planned

Drilling operations will soon follow the completion of the platform structure, and the wells to be drilled from it will be some of the first to seek oil beneath the continental shelf. In pioneering the development of the potential oil reserves bordering the Gulf Coast, the experience gained in constructing and operating from this platform should prove valuable in future operations. Resisting the heavy seas of the Gulf and the weather is a great task in itself, and the production of oil in the waters of the Gulf of Mexico depends upon the success of structures such as this.

Radar in Restricted Waters—concluded from page 54

need no correction. The picture on the scope can always be easily compared with the chart. Therefore, in most types of navigation where the Master is not very familiar with the coastline or harbour, it is the opinion of the authors that the true presentation is less confusing and therefore better. Relative presentation, on the other hand, places the heading flasher at the top of the scope, where it remains. The land areas, buoys and ships appear to manœuvre about the vessel as it alters course. This has one important disadvantage, in that the retentivity of the P.P.I. scope will cause the picture to smear in a fast turn. This confuses the picture for ten to fifteen seconds and this can be very annoying. The further necessity of correcting each relative bearing to true adds a burden when it is least desirable. Relative presentation has its greatest use by mariners very familiar with a region, and in navigation of rivers where the vessels do not even carry a compass.

Although in the U.S. a radar costs $8,000 to $15,000 to instal, and there is, of course, a continuing maintenance cost, there does not seem to be any doubt in the minds of the users that it is a good investment. When it is remembered that most commercial vessels have an earning power of several thousand dollars a day, this is not surprising. Another more interesting economic question is the effect that radar will have on insurance premiums. Although there have been, as yet, no general reductions, there have been a few scattered instances. It is expected that as radar proves itself, this trend will continue.

Notes of the Month

Norwegian Lighthouses Repaired.

The damage done to Norwegian lighthouses during the war, particularly during the German retreat in North Norway, has now been fully repaired, and 146 lighthouses and 2,231 beacons are again in working order. Plans for improving and extending the service are being carried out, particularly for new radio beacons and fog signals. The first radio beacons are expected to be ready for service early in 1950, and will be put into operation on Faerder at the entrance to the Oslo fjord and outside Aalesund.

Increased Trade at the Port of Liverpool.

A general increase in cargo handled at the Port of Liverpool in March is reported by the Mersey Docks and Harbour Board. Exports totalled 329,358 tons, in comparison with the previous month's figure of 286.349 tons; and foreign imports amounting to 547,341 tons were 78,226 tons above the February total. Imports of bulk petrol and fuel oil in March totalled 58,948 tons, as against the February figure of 36,467 tons.

Improvements at the Port of Antwerp.

Important improvement works are shortly to be put in hand at the Port of Antwerp. Access to the port will be improved by the construction of a second lock at Kruisschans, which will be 118-ft. long and 147-ft. 6-in. wide, and will have a mooring depth of 35-ft. at low water. The present Kruisschans lock, which was built in 1928, will be reserved for steamers leaving the port, and will be provided with a separate access channel. It is expected the work will take over 3 years to complete.

Mechanisation at the Port of Dundee.

Following a recent visit to the Port of Dundee by the Docks and Inland Waterways Executive, the Harbour Trustees are to consider the introduction of mechanical cargo handling equipment at the Port. Mr. Alexander Smith, General Manager and Engineer, reported at a recent meeting of the Trustees, that the Executive had laid great stress on the importance of improving the turn-round of shipping, and had also suggested the formation of a consultative committee on which all the interests concerned would be represented. The Trustees approved the setting up of the committee, and agreed that officials from the Port should study methods at other mechanised Ports in England and South Wales where goods similar to those dealt with at Dundee are handled.

Inverness Harbour Repairs.

At a recent meeting of the Inverness Harbour Trustees, it was stated that contracts had been placed for repairs and replacement work at the Harbour at a cost of £48,000. It was also reported that the Ministry of Transport had refused a grant towards the cost of the work, as they thought that the Trustees were financially able to meet this expense. The £48,000 repairs scheme includes extension to a groyne, the improvement of the quay wall, the resurfacing of the quay, and the provision of new railway lines. It is distinct from the Harbour development scheme which the Trust's engineer, Mr. Alex. Grant, M.Inst.C.E., has drawn up, and which is estimated to cost £89,000 and includes a new berth and extensive dredging.

Pakistan Ports to be improved.

The Governor General of Pakistan has announced that tenders from reputable firms from all over the world will be invited within the next few months for the development of Chittagong port in East Bengal, East Pakistan. Plans are also being made for the development of airports, and the building of hotels and waiting rooms at Karachi and Lahore in West Pakistan, and Dacca and Chittagong in East Pakistan.

The improvement of the port of Chittagong is to be put in hand without delay as the trade of East Pakistan, which used to pass through Calcutta, has now been diverted to Chittagong, where the existing facilities are quite inadequate. The port is at present under the control of the Eastern Bengal Railway, and the first essential, appears to be that a separate authority should be set up to arrange for the efficient berthing of ships and to prepare plans for the modernisation and expansion of the port.

TENDER.

LIMERICK HARBOUR COMMISSIONERS.
RIVER NAVIGATION LIGHTS.

The Limerick Harbour Commissioners are prepared to consider tenders from competent Contractors for the supply and erection of:—
3 River Navigation Lights for Buoys operated by D.A. Gas;
18 River Navigation Lights for Perches operated by D.A. Gas, or alternatively by Electric Storage Batteries;
in the Upper Estuary of the River Shannon, on buoys and perches to be supplied by the Commissioners.

Copies of Specification and Drawings may be obtained on application to the Harbour Engineer, Docks, Limerick, on deposit of Five Guineas, which will be returned on receipt of a bona fide Tender.

Tenders in sealed envelope, endorsed "Tender for River Lights" and addressed to "The Chairman, **Limerick Harbour Commissioners,**" 96, O'Connell St., Limerick," must reach me not later than Saturday, July 2nd, 1949.

The Commissioners do not bind themselves to accept the lowest or any tender.

D. O'BRIEN, General Manager.

SITUATIONS VACANT.

DOCKS AND INLAND WATERWAYS EXECUTIVE.

Applications are invited for the following positions:—

(a) **Senior Secretarial Assistant** at a starting salary of £750 per annum. Experience in the preparation of precis notes and draft reports is essential and a knowledge of the principles of Port and Dock operation and administration is desirable.

(b) **Secretarial Assistant** at a starting salary of £600/£750 per annum according to experience. Applicants must have a knowledge of dock working and administration, and of the structure and application of dock charges.

(c) **Engineering Assistant**, South Western Waterways Division, Gloucester, at a starting salary of £600 per annum. Applicants should be familiar with hydraulic engineering problems and preference will be given to Associate Members of the Institution of Civil Engineers.

The candidates selected will be expected, where eligible, to join a Contributory Superannuation Scheme, and in this respect to comply with whatever provisions are decided upon later for the Executive's staff as a whole.

Applications, stating age, qualifications, details of past experience, present position and remuneration, should be sent to the Secretary, Docks and Inland Waterways Executive, 22, Dorset Square, London, N.W.1, not later than 18th June, 1949.

FOR SALE.

5-TON GRABBING CRANE by Clarke Chapman & Co., Ltd. Level luffing and slewing, 38-ft. jib, max. radius 30-ft., tail radius 12-ft. Rail centres 11-ft. 10-in. Height of lift, from 28-ft. below to 14-ft. above rail level. A 4-motor crane for 400/3/50 supply, complete with Priestman Grab. In excellent condition. Full details from Cox & Danks, Ltd., Faggs Road, Feltham, Middx. ('Phone Feltham 3471.)

BUSINESS ANNOUNCEMENT

A New Scintillating Signal Lamp Light and Movement

It is a well known and established fact that any luminous Signal Light which has movement as well as illumination is superior to a stationary light of the same intensity. We are all familiar with the Rotating Lighthouse beam and the Railway Guard waving a red light or red flag to call attention in case of danger.

A new Magnetic (not a thermal flasher) Scintillating device which we illustrate is designed to produce a distinctive scintillating light.

Its principal feature is the provision of maximum visibility in a Scintillating beam, and its positive distinction from all other existing lights in the vicinity.

The scintillator is simply introduced into the lamp circuit or may control a number of lamps at different points.

There are many applications for such a device and one of importance to Docks, Harbours and Railways is a Scintillating Danger Signal used during shunting operations in marshalling yards, etc.

It has a further use in connection with Telephone Relay Circuits as a Calling Signal.

Further details can be obtained from C. W. DENNY at 8, Beaumont Court, Sutton Lane, Chiswick, London, W.4.